PAKISTAN COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

BIENNIAL REPORT
1959 & 1960

KARACHI
1962

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PAKISTAN COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

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I

INTRODUCTION

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INTRODUCTION

The First Quinquennial Report of the Council, which was published in 1959, gave a comprehensive account of the Constitution, objects, and development of the Pakistan Council of Scientific and Industrial Research in the first five crucial years of its existence from 1953 to the end of 1958. Two years have elapsed since then, and the activities of the Council and its laboratories have advanced sufficiently to warrant the publication of another report on essentially similar lines covering the two-year period from January, 1959 to December, 1960. While the basic plan of the present publication is the same as for the earlier Quinquennial Report, the background history and development of the Council and its laboratories have been considerably curtailed in the present report, and a rather more complete account is given of the status of the major research projects and development schemes of the Council.

Although the Council has taken its roots from the C.S.I.R. that was set up before partition in the early forties under the stress of World War II, the establishment of the Pakistan Council of Scientific and Industrial Research dates from April, 1953, when it was inaugurated as an autonomous body constituted under the Societies Act of 1860. The broad object in establishing the Council was to initiate, promote and guide scientific and industrial research primarily directed towards the utilisation of the indigenous raw-materials, and the development of industries based on them. The specific means of achieving this aim, as laid down in the Constitution of the Council, included a wide range of activities such as making grants-in-aid towards research in universities and other research institutions, awarding research fellowships, encouraging industry to contribute to the research effort, and collecting and disseminating scientific and technical information. The most important means laid down for prosecuting the aims of the Council, however, consisted in the establishment and development of its own national research laboratories, in which research and development work could be carried out with the stated object of "utilising the economic resources of the country in the best possible manner".

While the organization of the Council is in general based on the pattern employed in pre-partition India, the distribution and functions of the laboratories in Pakistan have been planned with reference to the specific requirements and conditions of the country. Consequently the pattern of regional laboratories, each dealing with a range of pure and applied scientific subjects of importance to the region concerned, has been adopted, and the experience of the first seven years of their working has confirmed the appropriateness of this choice of pattern for the P.C.S.I.R. Laboratories. In particular, this choice has been the means of fostering a spirit of team-work between scientists of similar and allied disciplines, on which depends in great measure the success of most research projects.

DEVELOPMENT OF THE NATIONAL LABORATORIES

The plans in 1954 called for the establishment of four National Research Laboratories at Karachi, Dacca, Lahore and Peshawar, comprising in all about 20 research divisions. The inevitable difficulties of providing permanent laboratory accommodation, trained personnel, and essential equipment, apparatus, and chemicals have greatly affected the pace of their development, but already in 1958 the Central Laboratories at Karachi were well established in temporary premises of 50,000 sq. ft. with a scientific staff of about 100, while the East Regional Laboratories at Dacca and the West Regional Laboratories at Lahore, were also functioning, each with a scientific staff of about 35, including several foreign-qualified senior research workers. A small nucleus for the North Regional Laboratories had also been functioning in the Peshawar University Science Block.

During the years 1959 and 1960, all the four laboratories have substantially increased the strength of their scientific staff, and the present position with regard to premises and staff recruited is summarized below:

(1) *Central Laboratories:* Nucleus premises of over 50,000 sq. ft. equipped and in use during the last seven years. Also a Building Research Station was transferred from the Works Division a year ago. Construction of permanent buildings has been started.

Scientific staff: 140, including twenty five with foreign qualifications.

(2) *East Regional Laboratories:* Nucleus premises of 18,000 sq. ft. equipped and in use during the last four years. Permanent premises with a floor area of 60922 sq. ft. nearing completion, and to be occupied towards the end of 1961.

Scientific staff: 50, including ten foreign-qualified research workers.

(3) *West Regional Laboratories:* Permanent premises with a floor area of 1,50,000 sq. ft. partially equipped and in use during the last five years.

Scientific staff: 70, including ten foreign qualified research workers.

(4) *North Regional Laboratories:* The Nucleus of the premises had been functioning in the Science Block of the Peshawar University for the last three years, and the premises have recently been shifted. Construction of the permanent buildings is nearing completion.

Scientific staff: 18, of whom four possess foreign qualifications.

PROGRESS OF RESEARCH WORK

The research activities of the Council cover a wide range of problems and comprise laboratory investigations in pure and applied fields, followed in most cases by pilot plant studies on the economics and optimum working conditions of the processes developed in the laboratory, before they are leased out to industrialists for commercial exploitation. Without such

pilot plant studies, the industrial exploitation of any new discovery or improvement in a manufacturing process is not practicable, particularly in the present stage of our industrial development with all its shortcomings in respect of technical know-how and background experience necessary for the production of goods acceptable to the consumers.

Applied Researches: It has been found expedient in some cases to set up semi-scale production units in the C. S. I. R. Laboratories for supplying large quantities of products for consumer testing and approval. As an instance of advantages that can accrue from such a procedure in the field of technological research and development, reference may be made to a series of important building materials evolved in the Laboratories of the Council, which have been fully accepted by the Pakistan Public Works Department, and the demand for which in building construction is increasing at a fast pace.

Among these mention must be made of "jutoid", a jute-based, rubberoid type of water-resistant matting for roof and packaging, which has now gone into commercial production, and of "balcrete", an air-entraining agent based on hydrolyzed hair and other waste proteins. About twelve thousand pounds of this latter product have been supplied from the Pilot Plant section of the C.S.I.R. laboratories, and have been used for producing about 70,000 cubic feet of foam or cellular concrete.

During the two years covered in the present report, several other products have reached the pilot stage, among which may be mentioned (1) Wood preservative "Cuprinol" a copper rosinate; (2) insecticides and fungicides from Gasoline, a waste product of the Daud khel Fertilizer factory, which cannot be used as a motor fuel on account of its high sulphur content; (3) development of protein-rich foods, based principally on fish meal, to supplement the diet of the common people; and (4) the production of dry and paste distempers based on proteins from cottonseed cake. In addition to these pilot plant studies, several new processes have been developed, and during the period under review, 15 patents have been obtained, while application for two more are pending in the Patent Office.

Fundamental Studies: A brief reference may be made in this connection to some programmes of importance that are presently engaging the attention of the Councils' scientific staff. Through comprehensive pharmacological investigations of the water-soluble complex, "Serpajmaline," isolated from the fresh undried roots of Rauwolfia serpentina, it had been established that (*i*) it does not carry the undesirable central depressent action responsible for many therapeutic complications in the treatment of high blood pressure, and (*ii*) that it shows a strong anti-fibrillant cardiac activity on the isolated heart of the rabbit, and that this activity is of the same order as that of Ajmaline. The present work of the Council in this field is concerned with systematic studies in the correlation of cardiac action with chemical structure in the ajmaline series of bases, and the results obtained so far have led to the formulation of what has been termed as "cardiophoric" grouping. This finding may well open up a new field of study in alkaloidal bases carrying cardiac activity and also has provided a basis for the synthesis of simpler substances modelled on the structure of ajmaline.

As regards physical research, it will be of interest to refer to further studies on inter-molecular forces and the theory of the liquid state, which have provided evidence for the presence of a well defined level-structure in the intermolecular energy of activation of viscous flow in polyhydric liquids like ethylene glycol and a monohydric liquid like water.

An important long-range investigation carried out under the Council with a close cooperation between physicists, chemists and chemical engineers, relates to the direct reduction of the low-grade Kalabagh iron ore with the help of Sui gas. As a result of these investigations, it has been found that, when the reduction is carried out after breaking up the ferruginous clay complex (chamosite) through roasting under specific conditions, sponge iron is obtained in a high yield. Arrangements are under way for assessing the economics and workability of this laboratory process through pilot plant investigations.

PUBLICATION, DOCUMENTATION AND INFORMATION

The research work of the Council is being published in a number of scientific journals. Since 1958, the Council has been bringing out its own quarterly "Pakistan Journal of Scientific and Industrial Research" which also accepts papers of scientific value contributed from laboratories of the Universities, specialized Research Institutes and other organizations. The April and July issues in 1959 were devoted to the publication of a "Rauwolfia Number", containing research papers on the chemistry, agriculture and pharmacology of Rauwolfia, followed by a comprehensive bibliography of the scientific literature on these subjects. A list of papers, totalling nearly fifty papers published by workers in the Council's laboratories during the two years under review is given in the Appendix (C).

Among it functions, the Council is charged with the task of encouraging and helping in the dissemination of scientific and technical information throughout Pakistan. A major contribution in this direction has been made through the establishment of PANSDOC, under the Council with UNESCO aid. The two main aims of the project, as approved by the Government and by UNESCO, are to establish a national centre as a first priority and then to initiate the development of scientific documentation throughout the country. The rate of progress towards the first of these goals would naturally affect the timing and amount of any effort that could be devoted towards the second.

As will be seen from the main body of this report, a point has been reached at which two of the three main services provided by PANSDOC, i.e. document procurement and bibliography compilation are operating at full load with only a relatively small amount of guidance from the UNESCO side (although this guidance is often on crucial matters), while the third main service, the translating service, is still leaning heavily on UNESCO aid. The document reproduction section is also carrying a heavy load, and with the growth of its work a great deal of reconstitution and further staff training has become essential. A major step has been the appointment as Head of PANSDOC of a Pakistani with three years of experience in the work of the centre. Action has been taken to establish sub-offices of

PANSDOC in Dacca and Lahore during 1961, which constitute, an important step towards the wider development of documentation services in the country. During the period under review, PANSDOC received requests for the compilation of 289 bibliographies, the procurement of microfilms or photocopies of nearly 3428 documents and for translation of 360 papers.

OTHER ACTIVITIES

The Council can also take credit for many other activities directed towards the industrial development of the country and in enhancing the utilization of its scientific and technical manpower. It has, in effect, been functioning as a scientific advisory body to the Government in the industrial and other related fields, and we may particularly refer in this connection to the project of a synthetic dye-stuffs factory in Daud khel, which was initiated and vigorously followed up by the P.C.S.I.R. in close association with the Ministry of Industries before it reached the stage where it could be taken over by the P.I.D.C. as a sound proposition.

Among the important national activities initiated by the P.C.S.I.R. in the year 1959 perhaps the most significant is the appointment by the President of Pakistan of a twelve-man Scientific Commission with the Minister of Industries (who is also the President of the C.S.I.R.) as chairman, and several eminent scientists, administrators and educationists as its members. The first meeting was inaugurated on the 4th of August. 1959, by the President of Pakistan, F. M. Mohammad Ayub Khan, who, speaking of the Scientific Revolution, said, "We are just beginning to feel its impact and the sooner we realise the benefits of its all-pervading influence the better. As a result of this revolution, science has emerged as a faith on which societies are built today". The President further said that his Government was determined to lift the status of scientists in society and to offer the right careers to young men devoted to the pursuit of scientific knowledge and research. Mr. Abul Kasem Khan, the Chairman of the Commission (and President of the Council of Scientific and Industrial Research) referred in his address to some of the problems connected with the development of scientific research in Pakistan, and the application of its results in the various sections of the national effort relating to the welfare of the people. He particularly emphasized the necessity of wise planning and its effective implementation in organizing scientific research in the country.

The Commission was helped in its deliberations by five advisers from overseas, including three eminent scientists and two scientific administrators. The Commission collected evidence by first issuing a comprehensive questionnaire to individual scientists, educational and scientific institutions and heads of various laboratories, and later by visiting, along with its advisers, various educational institutions, research institutes and laboratories in both wings of the country and interviewing experts and other people connected with scientific activities at different levels. This tour was completed in December, 1959, and an outline of the draft report was prepared soon after. After prolonged discussions and revisions of this draft, the Commission's Report in the final form was prepared in the middle of 1960, and presented to the President of Pakistan on 2nd September, 1960.

The report has been accepted after examination by the Presidential Cabinet, and some of its more important recommendations deserve mention here. The basic plan for the national coordination of research activity and the betterment of the conditions of the scientific workers envisages the creation of a National Science Council with a number of autonomous constituent Research Councils under it to organize work in the main fields of scientific endeavour, namely (1) the Scientific and Industrial Research Council, (2) the Food and Agriculture Research Council, (3) the Medical Research Council, (4) the Works and Irrigation Council, and (5) the Atomic Energy Council. The plan envisages the transference of many existing laboratories to these constituent Councils. The Commission has also recommended certain improved scales of pay for scientific workers in general and the scientists in the Foundation's Service in particular, so as to make the emoluments of scientists commensurate with their qualifications and comparable with those being paid in scientifically developed countries in the West.

FUTURE DEVELOPMENTS

Before closing this brief introduction to the activities of the C.S.I.R., it will be of interest to indicate some aspects of its future plans for development.

Apart from the important fundamental studies on the accurate measurement of intermolecular forces between molecules in mono-and poly-hydroxylic liquids, the Physical Research Division has, during the earlier years of the Council's activities functioned largely as a support for the applied researches carried out in the other divisions of the C.S.I.R. laboratories. It is largely through this collaboration that it has been possible to carry through such projects as the structural analysis, beneficiation and direct reduction of the low-grade Kalabagh iron ore, the development of a variety of heat-insulating building materials, and infra-red and ultra-violet studies of several complex organic compounds obtained as important products from indigenous medicinal plants.

While the importance of such co-ordinated activity can hardly be over-stressed, it is necessary to note here that the development of independent physical reserach as such is already taking place, and programmes of work in accoustics, ultrasonics, properties of insulators and semi-conductors, spectroscopy and X-ray structure analysis are well advanced. For the future development of a full-fledged Physics Research Division, it will be necessary also to initiate research work in fields like low-temperature physics, microwave techniques, gamma-ray spectroscopy, and gas discharges. However, such a programme must necessarily be co-ordinated with the provision of trained personnel, which is now steadily becoming available through the return of our trainees from abroad.

With the increasing availability of scientific and technical staff, for which a more vigorous training programme is being worked out, there will also be a general extension and expansion of the present activities in Scientific and Industrial Research, and a more effective association with industry, aiming at increased output and improved industrial products. It is expected that prominent industrial enterpreneurs will finance some

of the projects of the Council, which have an immediate bearing on national economy and their own specific field of industry.

Among the more important projects planned for the following years are: (1) the pilot-plant development of a simple economic process using Sui gas for reduction of the low-grade Pakistani iron ore for the iron and steel industry; (2) the development of new industrial applications of lac and investigations on fundamental problems relating to its cultivation; (3) the setting up of a Drug Research Institute at Chittagong for carrying out investigations on the medicinal plant resources of East Pakistan; (4) studies on the preservation and processing of marine and riverine fish and development of food and fruit preservation techniques for the food industry; (5) development of cellular light-weight burning and fire bricks and of low-cost substitutes for marble; (6) development of silica and sandlime bricks, and utilisation of gypsum for building materials; (7) modification of Portland cement with a view to securing sulphate resistance and high flexural strengths; (8) development of wetting agents for increased strengths in concrete, using less amount of cement and ungraded aggregates; (9) production of industrial fibres from pine apple leaves and other plant products; (10) utilisation of Bhoj Putr (Betula utilis); (11) detailed investigations on the medicinal plants of West Pakistan; (12) utilisation of number of agricultural and industrial wastes; (13) low-cost housing schemes; (14) studies in electric insulation materials; (15) electric behaviour of hydrated solids.

Scientific research and development call for a prolonged study, needing patient and persistent effort, and it is only in stages and in the fullness of time that we can hope to tackle successfully the many and varied scientific and technological research problems of the country. While it is realised that the work relating to the solution of some of the problems and the establishment and functioning of the Central and Regional Laboratories could have moved a good step faster if it were not for frustrating delays beyond its control, the Council can claim to have achieved a fair measure of success in a comparatively short span of life since its inauguration in 1953.

II

ORGANISATION OF THE COUNCIL

ORGANISATION OF THE COUNCIL

The Pakistan Council of Scientific and Industrial Research is an autonomous body registered under the Societies Act of 1860. It is responsible for the administration of the Research Fund to which grants are made by the Government of Pakistan from year to year.

The Council enjoys full freedom in the planning of its research programme and has an anchorage in the Government through the Department of Scientific and Industrial Research within the Ministry of Industries. The Director of the Department is *ex-officio* Director of the Council. The Department takes care of the more representative functions and co-ordinates the Council's work with the research going on under the auspices of other Ministries or Departments.

GOVERNING BODY

The administration of the Council is vested in the Governing Body, of which the Minister for Industries, Government of Pakistan, is the President. The Governing Body has 23 members, including of course, the Minister for Industries, representatives of the Central and Provincial Governments, eminent scientists and industrialists.

The management of the affairs, funds and revenues of the Council is vested in the Governing Body, subject to such general directions in respect of expenditure as the Central Government may issue from time to time. All decisions on matters of policy, budget allocations, sanctioning grants for specific research schemes and other matters falling within the scope of the activities of the Council are taken by the Governing Body. The President of the Council is vested with wide financial powers within the sanctioned budget allocations.

The Governing Body in turn is responsible to the Council, which consists of 36 members composed of representatives of the Central and Provincial Governments, eminent scientists, industrialists and educationists.

The term of office of the members of the Governing Body, as well as the Council, is three years.

ADVISORY BODIES

A standing advisory body, viz, the Central Planning Committee of the Council, advises the Governing Body on all matters relating to the planning and construction programme of the laboratories, and on general technical and policy matters. It consists of 8 members nominated by the Governing Body.

The Central Planning Committee has also been charged by the Governing Body with the responsibility to function as the Research Utili-

sation Committee in respect of the leasing out of the processes evolved under the Council for large scale commercial development.

The Governing Body has also constituted six Research Advisory Committees. The Director of Scientific and Industrial Research is an *ex-officio* member of each of these Committees. All research schemes submitted to the Council by Universities or other research institutions for grant-in-aid are referred to the appropriate Research Committee for scrutiny and recommendation. The six Research Committees are: (1) Chemical Research Committee; (2) Drugs, Pharmaceuticals and Pest Infestation Research Committee; (3) Industrial Fermentation and Biological Products Research Committee; (4) Building Research Committee; (5) Fuel Research Committee; and (6) Physical Research Committee.

ADMINISTRATION

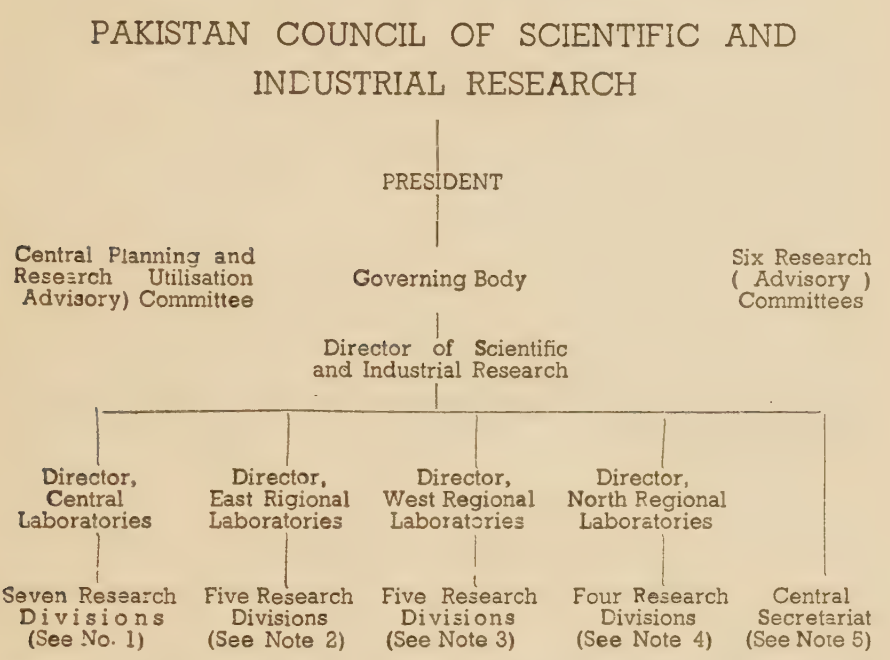
The Director of Scientific and Industrial Research is the principal executive officer of the Council. He is responsible for the day-to-day administration of the Council, and exercises supervisory control over its technical and research activities, including the work of the Central and the Regional Laboratories and research under the grant-in-aid schemes. He is a member of the Council and also of the Governing Body, the Advisory Bodies and the Council's Selection Board (which is responsible for making higher appointments), and is Chairman of the Council's Selection Committee.

REGIONAL LABORATORIES

The direction of scientific research and the day-to-day administration of the regional laboratories is vested in the Directors of the respective laboratories. The scientific work of the laboratories is carried out in the various divisions under the guidance of the Heads of Divisions. The Registrars or Administrative Officers look after routine administrative and financial matters.

ORGANIZATIONAL CHART

The following chart depicts the inter-relationship of the various units under the Council of Scientific and Industrial Research.


PAKISTAN COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH
PRESIDENT
Central Planning and Research Utilisation Advisory) Committee
Governing Body
Six Research (Advisory) Committees
Director of Scientific and Industrial Research
Director, Central Laboratories
Director, East Rigional Laboratories
Director, West Regional Laboratories
Director, North Regional Laboratories
Seven Research Divisions (See No. 1)
Five Research Divisions (See Note 2)
Five Research Divisions (See Note 3)
Four Research Divisions (See Note 4)
Central Secretariat (See Note 5)

Note (1) Central Laboratories. Research Divisions are (1) Physical Research and Testing. (2) Chemical Research. (3) Biochemical Research, (4) Drugs and Pharmaceuticals Research. (5) Building Materials Research (6) Fuel Research. (7) Plastics Research.

Note (2) East Regional Laboratories. Research Divisions are (1) Leather Research. (2) Fuel Research. (3) Glass and Ceramics Research. (4) Food and Fruit Technology. (5) Plant and Animal Products Research.

Note (3) West Regional Laboratories. Research Divisions are (1) Metallurgical (including Ore dressing and testing of minerals). (2) Industrial Fermentation Research (3) Oils and Fats Research. (4) Food Technology Research. (5) Glass and Ceramics Research.

Note (4) North Regional Laboratories. Research Divisions are (1) Indigenous Drug Research. (2) Fruit Technology Research. (3) Wool Research. (4) Mineralogical Research.

Note (5) Central Secretariat responsibilities are (1) Meetings of Council, Governing Body and Advisory Bodies; (2) General and Policy Matters ; (3) Finances. (4) Research Schemes; (5) Dissemination of Scientific and Technological Information; (6) Patents and Publications; (7) Awards of Fellowships and Scholarships; (8) Research Utilisation; (9) Liaison with Industry; (10) Planning and Construction.

III

DEVELOPMENT OF NATIONAL LABORATORIES

DEVELOPMENT OF NATIONAL LABORATORIES

Although at the time of independence, there existed more than a dozen separate laboratories and institutes under the Indian Department of Scientific and Industrial Research, none of these, because of their geographical location, fell to the share of Pakistan. On the recommendations of the Planning Committee constituted by the Governing Body of the Pakistan Council of Scientific and Industrial Research, a plan was approved in 1953 for the establishment of four National Laboratories under the Council, viz. the Central Laboratories at Karachi and three Regional Laboratories at Dacca, Lahore and Peshawar, to take care of industrial problems specific to these areas. Each of these four laboratories now comprise a number of Research Divisions with special reference, in case of the Regional Laboratories, to the needs of the areas they principally serve.

CENTRAL LABORATORIES, KARACHI

(1) Physical Research and Testing Division;

(2) Chemical Research Division;

(3) Biochemical Research Division;

(4) Drugs and Pharmaceuticals Research Divisions;

(5) Building Materials Research Division;

(6) Fuel Research Division; and

(7) Paints and Plastic Research Division.

EAST REGIONAL LABORATORIES, DACCA

(1) Plant and Animal Products Research Division (covering work on minor forest products, and biological, agricultural and industrial wastes);

(2) Fuel Research Division (principally for work on the peat and lignite coal deposits of the area);

(3) Food and Fruit Technology;

(4) Leather Research Division (principally providing facilities for investigations on the tanning material resources of the region); and

(5) Glass and Ceramics Research Division.

WEST REGIONAL LABORATORIES, LAHORE

(1) Ore Dressing and Metallurgical Research Division;
(2) Industrial Fermentation Research Division;
(3) Oils and Fats Research Division,
(4) Glass and Ceramics Research Division; and
(5) Food Technology Research Division.

NORTH REGIONAL LABORATORIES, PESHAWAR

(1) Indigenous Drugs Research Division;
(2) Fruit Technology Research Division;
(3) Wool Research Division; and
(4) Mineralogical Research Division.

In deciding on the ultimate location of the laboratories, utmost consideration has been given to placing them in the vicinity of the Universities in order to facilitate closest possible co-operation between the laboratories of the Universities and the Council. While such close association can be of mutual benefit in any country, it is positively imperative in Pakistan, on account of our comparative shortage of scientific and technological personnel, to ensure an overall co-ordinated progress of scientific teaching and research.

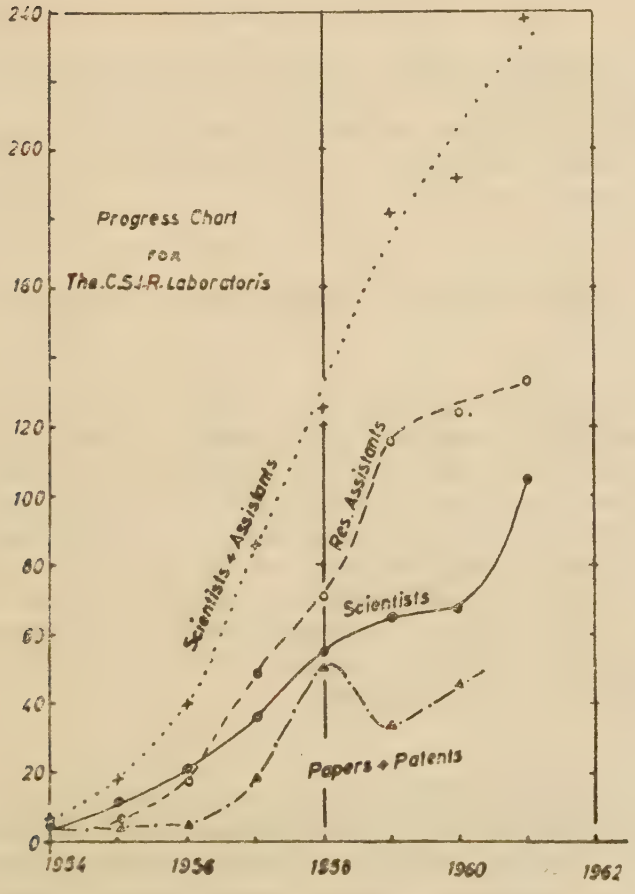
While steps were being taken for the planning, construction and equipment of all these four laboratories under the guidance of local Planning Committees, arrangements were made for setting up their nuclei in temporary buildings on the pattern of the nucleus of the Central Laboratories which started functioning fully at Karachi in 1954 with about 40,000 sq. ft. of covered space temporarily allotted to it. It has lately appeared desirable to examine quantitatively the progress of the scientific work of the C.S.I.R. Laboratories in relation to the staff already employed and being recruited. As a first step towards this, series of graphs have been drawn in the accompanying diagram showing the year-by-year position with regard to the following:

(*i*) Total output for the four national laboratories of the Council, reckoned in terms of patents and published papers from January 1st to December 31st of the particular year. This is shown by the chain-dotted line.

(*ii*) Total number of scientists i.e. technically qualified people in the officer's cadre (Class I and Class II) on January 1st, shown by the full line graph.

(*iii*) The total number of qualified research assistants, shown by the broken line; this enumeration includes junior technical assistants.

(*iv*) Total scientific staff, i.e., scientists plus research assistants on January 1st of the particular year. This is shown by the uppermost (dotted) line.



Two facts will be seen from these comparative graphs. First, that the early steep rise in the total scientific staff is now being followed by a more gradual approach to equilibrium, and, second, that the growth of output has, on the whole, kept pace with the number of scientists employed in the Council's laboratories. Small fluctuations can be noted, namely, the exceptionally high output for the year 1958 followed by an abnormally low one in the next year 1959. This finds an explanation partly in the holding over of papers for the first year of the Council's own Journal, which began publication in January, 1958, and partly in the fact that the graph for output does not take account of the long drawn-out pilot plant work being undertaken for the development of the Council's newly patented industrial processes. A contributary factor may be the frustrating delays in important administrative decisions, particularly those relating to promotions, as shown by the flat part (1958—1960) of the graph for the number of scientists.

Some details of the set-up of the Central Laboratories and the three Regional Laboratories in regard to staff, buildings, and other facilities are given below. These are necessarily sketchy, but it is hoped that they will serve to convey a better idea of the degree of progress achieved during the period under review.

THE CENTRAL LABORATORIES, KARACHI

Present Buildings and Equipment: Although still housed in converted barracks belonging to the Pakistan Naval Hospital, the Central Laboratories have grown somewhat in area through the aquisition of still another barrack, making a total covered area of about 50,000 sq. ft. More apparatus and capital equipment has been purchased during the last two years to keep pace with the needs of the growing staff, and all the seven research divisions of the laboratories are now functioning fully. In addition to their Pilot Plant Research Station, the Central Laboratories have now gained a Building Research Station, which was transferred in 1959 from the Works Division of the Pakistan Central Government.

Personnel: The overall administration of the laboratory is vested in the Director, while the work of the individual divisions is controlled and directed by the Heads of Divisions and Principal Scientific Officers, who have under them a number of qualified research workers of long standing,

including several with foreign qualifications. The present distribution of research staff over the individual divisions is shown below:

Division	Head of Division	Principal Scientific Officers	Senior Research Officers	Research Officers	Research Physicists, Chemists, etc.	Research Assistants
Physics	—	1	—	1	11	14
Chemical	1	—	3	3	4	21
Biochemical	1	—	1	—	2	6
Biological Evaluation Section	—	—	1	—	3	6
Drugs & Pharmaceuticals	—	1	1	2	3	7
Pharmacological Section.	—	—	—	3	5	5
Fuel Research and Pilot Plant Station	1	—	1	—	2	7
Building Materials & Building Research Station	—	—	1	—	2	3
Paints & Plastics	—	—	1	1	2	5
Chemical Engineering & Workshop Section	—	—	—	2	2	3
TOTAL	3	2	9	12	36	77

The tabulation shows a nearly one-to-one ratio between the numbers of the research assistants and the research scientists i.e. the Officers cadre from Senior Research Officers down to Research Physicist/Chemist, etc. Of course these workers are assisted by about one hundred Technicians and

Laboratory Assistants, recruited from amongst people with good technical skills but poor academic qualifications.

Auxiliary Services: (*i*) The library now has nearly 8,000 volumes on its shelves and subscribes to 120 periodicals. In addition it receives 200 periodicals in exchange, and another 130 free of cost through the courtesy of the U.K. High Commission, the West German Embassy and the U.S. Information service, and other embassies. Back numbers of serveral U. S. Journals are being received from the Asia Foundation.

(*ii*) The stores occupy an area of 10,000 sq. ft. and hold a total of 11,000 different items on the stocks, valued at Rs. 64 lakhs, including the equipment issued to the laboratories. Of this total value Rs. 40 lakhs correspond to scientific equipment, Rs. 20 lakhs to glassware and delicate apparatus, and Rs. 4 lakhs to chemicals. The stores are managed by an Assistant Stores Officer, who is aided by Stores Supervisor, a Senior Storekeeper and four Store-keepers for the sub-stores.

(*iii*) An office has been set up at the laboratories to look after the administration, accounts and local purchases for the various divisions of the laboratories. It is headed by an Administrative Officer, aided by an Assistant Administrative Officer and two Superintendents.

Permanent Laboratory Builings: The permanent buildings of the Central Laboratories of the Pakistan Council of Scientific and Industrial Research are to be built on an 150- acre plot, allotted by the Government adjacent to the Karachi University Campus on the Country Club Road, about ten miles inland from Karachi.

The laboratory buildings are being planned by an expert architect and will have two to three floors and a frame structure. The individual blocks of the laboratories would be about 18 feet wide, built on either side of a central corridor ten feet in width. It is also intended to construct residential houses for officers and essential staff simultaneously with the laboratory buildings. The planning and construction are being organized by a Building Committee, and the construction of some junior staff quarters has already commenced.

The main buildings will house the offices of the Director, Pakistan Council of Scientific and Industrial Research, the Director of the Central Laboratories, the seven Research Divisions and PANSDOC, in addition to the Pilot Plant and Workshop Sections. The main block will also house a Library and an Auditorium.

The Foundation Stone of the buildings was laid on 6th April, 1959, by the President of Pakistan, Field Marshal Mohammad Ayub Khan, at a well-attended ceremony.

THE REGIONAL LABORATORIES

The Regional Laboratories have advanced rapidly during the last two years, both as regards the construction of permanent laboratory buildings and the establishment of effective research groups to tackle the more important applied research problems of the respective regions.

1. EAST REGIONAL LABORATORIES

These Laboratories started functioning in 1956-57 on 18,000 sq. ft. of covered space in the East Pakistan Polytechnic Institute at Tejgaon, Dacca. Since their inception, they have now grown to a stage where four of the five research divisions are functioning fully, and the laboratories are expanding their activities further.

Permanent Buildings: After several early setbacks, the work of construction was begun in the 28 acres of land allotted by the Government of East Pakistan in Dhanmondi area of Dacca. The Food Technology building was completed in 1960, and the internal fittings are now being put in. The building is of a quadrangular type with a rectangular courtyard inside and comprises three stories from the ground level. The front has been made as a reinforced concrete honeycomb network, which extends throughout the 1st and 2nd stories. Construction of an identical building on the other side of the proposed main block is also being started.

The Registrar's office has already been shifted to the site of the laboratory and the various research divisions will follow within a few months.

Personnel:

Director	1
Heads of Division	1
Principal Scientific Officers	2
Senior Research Officers	5
Leather Technologists	2
Research Chemists etc.	4
Technical Assistants	33
Junior Technical Assistants	3

The staff has been considerably strengthened by the return of several of the Council's nominees after receiving advanced training overseas.

2. WEST REGIONAL LABORATORIES

Though not yet fully staffed and equipped, all the five Research Divisions of these Laboratories viz., (*i*) Metallurgy and Ore Dressing, (*ii*) Biological Evaluation and Fermentation, (*iii*) Oils, Fats and Waxes, (*iv*) Glass and Ceramics, (*v*) Food Technology, have got well into their stride.

Land and Buildings: Out of 100 acres of land obtained as a gift from the West Pakistan Government, about 75 acres, which lay on the estern side of Ferozepur Road, had been initially taken possession of and construction started thereon. Accordingly, the Food Technology, Glass and Ceramics and Pilot Plant Blocks had already been constructed and various Research Divisions have been set up therein.

Construction of the Main Block, which will house specialised laboratories including analytical and bacteriological, the main offices, the library etc., will, according to our building schedule, start in about three year's time. To facilitate visits to and work in these laboratories by outside scientists, a guest house is also planned for construction in due course.

As the work of the Laboratories progressed apace and the staff increased, the necessity for a recreation club for the staff was felt, and this was accordingly set up in one of the buildings. A plot of land, adjoining the Pilot Plant Block, has also been set apart as a play ground for the staff, where they (especially the resident staff) will be able to play games like cricket, hockey, foot-ball, volley ball, badminton, tennis, etc., during their leisure hours. Behind the Pilot Plant Block, spacious accommodation for the workshop is being constructed at an estimated cost of Rs. 1,52,000. It will be ready shortly and the workshop will then shift there from its temporary site.

As regards residential accommodation, some headway has been made, though the major programme will be taken in hand only when the remaining 25 acres of land across the Ferozepur Road on its western side is taken possession of. While action in this connection is in progress, the following residential accommodation near the laboratories blocks has so far been constructed:

1. Bungalow for Head of the Division 1
   (Ready and occupied).

2. Senior Research Officer's Bungalows .. 2
   (under construction)

3. Technical Assistants' quarters 28
   (Combined E & F type).
   (About 25% completed and the rest will be ready by the close of the financial year.)

4. 'G' type quarters 18
   (Out of these 6 are yet under completion).

Construction of these bungalows and quarters would cost about Rs. 7,00,000, which includes about Rs. 64,000 for a provisions centre under construction. The internal connecting roads are being metalled, and the lawns and gardens with trees and flower beds are in the process of being properly planned and laid. All this will give quite a picturesque look to the surrounding.

Equipment: During the two years under review, some of the much-needed equipment for Food Technology, Glass and Ceramics, Biological Evaluation and Fermentation Divisions, as also some spare parts and accessories for equipment already in use, were received, the total cost being Rs. 786,907.80. Equipment worth another Rs. 4,00,000 is shortly expected.

Library: A library well-stocked with scientific and technical books containing the results of latest research in various subjects, is a "must" for any research laboratory. During the last two years 2,035 volumes of scientific and technical books were added to the library, and good use of these books is being made by the research staff.

Personnel: During the last two years, the situation with regard to the research staff has became somewhat better. At present, the West Regional Laboratories have nine foreign qualified research workers and another 8 are still studying abroad under various training schemes. The comparative figures of staff as they stood at the end of 1958 (i.e. the end of the period covered by the quinquennial report) and 1960 are given below:

	At the end of 1958	At the end of 1960
Director	1	1
Physicist	1	— (died)
Head of Division	—	1
Senior Research Officers	—	5
Research Officer	5	4
Research Chemists	4	4
Technical Assistant	23	44
Junior Technical Assistant	—	7

One of the Senior Research Officers was awarded a Post-graduate Fulbright Fellowship by the United States Educational Foundation for a period of 300 days in the field of Food Technology at Massachusetts Institute of Technology, Cambridge, Mass, U.S.A. to which he proceeded in September, 1960. Further, several members of the staff were granted leave for studies abroad, while some others proceeded to foreign countries under Technical Assistance Programmes sponsored by the Colombo Plan and F.A.O.

The Director of the Laboratories visited the University of Cambridge under an award of a Bursary by the Royal Society and Nuffield Foundation, London, to study modern techniques in organic chemistry. He stayed there for about 2½ months; thereafter he paid brief visits to various scientific and industrial institutions in Northern England and Scotland, and on his way back he also visited Germany in September, 1960.

3. NORTH REGIONAL LABORATORIES

Permanent Buildings: As previously stated in the Quinquennial Report (1953-58), the nucleus of the North Regional Laboratories in Peshawar was started in 1955 in one wing of the Biology Block of the University of Peshawar. In 1955, 110 acres of land were acquired for the Laboratories, and during 1957-58 development of the site, construction of residences and water supply system were taken up.

Construction of the main wing of the laboratory building was undertaken early in 1959, and the stores were shifted there by the end

of that year. In 1960 the four wings of the Laboratories meant for housing the four Research Division were completed. The equipment at the original site in the University was shifted to the new premises in the middle of the year, and research work was started in those portions of the building that could be furnished and equipped quickly. During the period under review, construction of the workshop, gas plant, animal house and a number of staff quarters has also been completed, and considerable progress has been made in the construction of the pilot plant building.

Construction of one of the main blocks, meant to accommodate the Offices, Library, Museum, Auditorium, etc., could not be taken up so far, and as a result the offices are now housed in one of the research wings. Construction of this administrative block as well as some more residential houses will be taken up in 1961-62 and it is hoped that the building programme of these laboratories will be completed by the end of 1963.

Equipment: Laboratory equipment worth approximately rupees 3 lacs was obtained by the end of 1958. During 1959-60, orders were placed for pilot plant and laboratory equipment of various kinds worth Rs. 10 lacs. Some of these items of equipment have already arrived and the remaining items are expected in about a few months time. Attempts are also being made to obtain more equipment for the four research divisions so that research work may be started in full swing as soon as the personnel position is further improved.

Library: At present the Library has on its list 2,837 books valued at about Rs. one lakh, and 110 Scientific Journals are being subscribed regularly for the Library. Latest books on subjects of interest to the various research divisions of the Laboratories are being ordered, as and when published, and the library is steadily growing in size.

Scientific Staff: The position of the scientific staff at the end of 1960 was as follows:—

Director	1
Senior Research Officers	2
Research Officer	1
Research Pharmacologist	1
Research Chemists	2
Technical Assistants	9
Junior Technical Assistants	2

IV

CENTRAL LABORATORIES

CENTRAL LABORATORIES

PHYSICS AND PHYSICAL CHEMISTRY

1. Investigations on the Thermal Conductivities of Binary Mixtures: The previously reported work carried out in these laboratories on the thermal conductivity of concretes containing various proportions of rice-husk ash has led to a detailed investigation of the thermal behaviour of binary mixtures with particular reference to porous materials, which can be considered as a homogenous mixture of the solid phase with air. Theoretical formulae for the thermal conductivity of such materials were derived (on the basis of certain assumptions) by Maxwell and Rayleigh, and later by Russell, but, when compared with recent measurements on cellular concretes in the Building Materials Division of the Australian C.S.I.R.O., these formulae were found to be in error by as much as 50%. It was therefore necessary to examine the whole problem *ab initio*, and to set up a better model for the heat conduction in a homogenous mixture of two components A and B. This was accomplished by using a three-dimensional stacking of slabs composed of alternate layers of A and B, which arrangement yields a practically isotropic and homogenous block. A step-by-step theoretical evalution of the thermal conductivity of these slabs and blocks yields the following simple formula for the thermal conductivity K_m of a mixture containing X_a parts of A and X_b parts of B by volume:

$$K_m^{1/3} = \frac{X_a}{X_a + X_b} K_a^{1/3} + \frac{X_b}{X_a + X_b} K_b^{1/3}$$

This formula is found to be in excellent agreement with the above-mentioned experimental data on cellular concretes, and is being used to analyse the anomalous effects previously observed in concretes of rice-husk hsa

Publication: Studies in the Properties of Heat-insulating Building Materials. Part II—The Thermal Conductivity of Binary Mixtures with Special Reference to Cellular Concrete by M.M. Qurashi and A.K.M. Ahsanullah, Pakistan J. Sci. Ind. Research, 2, 1 (1959).

2. Development of Rapid Dynamical and Semi-Dynamical Methods for Measuring the Thermal Conductivities of Poor Conductors: The semi-dynamical method was devised for reducing the time required for a single measurement by obviating the necessity for an actual ettainmnet

of equilibrium. Instead, it was found possible to obtain the equilibrium temperature of the brass disc in Lees and Chorlton's method by an extrapolation of the linear plot of rate of rise of temperature against temperature (of the brass disc). While the linearity of this plot has been experimentally confirmed in numerous experiments, another technique has been developed by extrapolating this very straight line in the opposite direction, i.e., towards the initial condition when the brass disc is at room temperature. A simple theoretical analysis shows that the thermal conductivity can be obtained directly from this extrapolated value of the rate of rise of temperature, provided that we add one-third of the thermal capacity of the test sample to that of the brass disc. These deductions are found to be in accord with experiments, which have indicated an accuracy of 3 to 5% for the technique.

Publications: (1) An Accurate Rapid Semi-dynamical Method for Determination of the Thermal Conductivity of Poor Conductors by M. M. Qurashi and S. H. Rizvi, Pakistan J. Sci. Ind. Research, 2, 236 (1959).

(2) A Fully Dynamical Rapid Method for Determination of the Thermal conductivity of Heat-insulating Materials, by S. H. Rizvi, M.M. Qurashi and A.K.M. Ahsanullah, Pakistan J. Sci. Ind. Research, 3, 110 (1960).

3. X-Ray Structural Investigations: (a) X-ray and Magnetic study of the Magnetic Fraction of Steam-Treated Makerwal coal: The preliminary study had shown the presence of Fe_3O_4 in the magnetic fraction and also indicated the need for further examination of the role of sulphur present in it. Through a combination of Magnetic Susceptibility Measurements on the variously treated coal, and X-ray analyses of the treated coal samples as well as the successively separated magnetic fractions, it has now been possible to establish the presence of four major constituents, three of them sulphides, viz. Fe_nS_{n+1}, FeS_2, FeS and Fe_3O_4. The magnetic measurements enable the quantities of paramagnetic Fe_nS_{n+1} and ferromagnetic Fe_3O_4 produced at the various treatment temperatures to be estimated, while the X-ray patterns provide semi-quantitative estimates of all the four iron compounds. For the magnetic fraction obtained from the coal treated at 350°C, we obtain Fe_nS_{n+1}, 5%; FeS_2, 5%; FeS, 2%; and Fe_3O_4, 4%; this gives total iron and pyritic sulphur contents in agreement with the chemical estimations.

The magnetic measurements indicate that in the first stage FeS_2 is changed into Fe_nS_{n+1}, which later reacts to give Fe_3O_4.

Publication: Magnetic and X-ray Study of the Magnetic Fraction of Steam-treated Makerwal Coal by Shafqut Husain, S. H. Rizvi and M. M. Qurashi, Pakistan J. Sci. Ind. Research, 3, 40 (1960).

(b) EXAMINATION OF ASBESTOS-LIKE MATERIAL FROM HINDUBAGH: In an effort to identify it with one of the known varieties of asbestos, this fibrous mineral was subjected to chemical and X-ray fibre pattern analysis, but with very anomalous results. X-ray powder diffraction patterns were then taken and showed that it was primarily a mixture of Brucite ($Mg(OH)_2$) with Dolomite ($MgCO_3$. $CaCO_3$). The actual asbestos present could only be pin-pointed after considerable difficulty as chrysotile, present in amounts of about 10%, and was later identified by means of X-ray fibre and powder patterns of the residue obtained from acid treatment of the original sample. The quantities of the brucite and dolomite were estimated at 50% and 40% respectively, which lead to figures of 40% for magnesium oxide and 12% for calcium oxide, in satisfactory agreement with the chemical estimation.

Publication: Chemical and X-ray Examination of an Asbestos-like Mineral Occuring in Hindubagh, by T. R. Khan, M. Sualiheen and S. H. Rizvi, Pakistan J. Sci. Ind. Research, 3, 36 (1960).

(c) X-RAY STUDY OF THE DIRECT REDUUTION OF KALABAGH IRON ORE WITH SUI GAS: In continuation of the previously described collaborative research by the Chemical, the Physics and the Chemical Engineering Divisions, an X-ray study has been carried out on the new two-stage process for the direct reduction of Kalabagh iron ore with natural gas from Sui. The constituent phases present in the magnetic and non-magnetic fractions obtained from different combinations of the roasting and gas treatments have been determined, and the optimum conditions for the recovery of iron are deduced by interpretation of the chemical and X-ray data.

Publication: Reduction of Kalabagh Iron Ore (Containing Ferruginous Clay) with Sui gas, by S.I. Ali, M. Ismail and G. Hahn in collaboration with L. Ahmad, S. H. Rizvi and M. M. Qurashi, Pakistan J. Sci. Ind. Research, 2, 197 (1959).

4. STUDIES IN THE RELATIONSHIP BETWEEN VISCOSITY AND INTER-MOLECULAR ENERGY (LEVEL STRUCTURE): The earlier findings showing the presence of discrete jumps in the inter-molecular energy of activation of viscous liquids have led to a series of fruitful experimental investigations of these phenomena in the case of several hydroxylic liquids, namely, water, ethylene glycol and alcohol. The teachnique has now been refined to a stage where temperatures are controlled to within $\pm$ 0.002°C., the temperature interval measured to 0.001°C., with a Beckmann differential thermometer and the viscosities obtained correct to 1 part in 20,000. This degree of control leads to measurements of the inter-molecular

energy of activation to an accuracy of about $\frac{1}{2}\%$, which enables the small discontinuities in this energy to be faithfully recorded, especially when the measuring interval, $\triangle$ T, is reduced to 1°C.

The refined measurements on ethylene glycol with $\triangle T = 2.5°C$. have in addition to confirming the preliminary results (previously reported) given indication of a regular level-structure in the inter-molecular energy. The energy remains constant for several degrees Centigrade, and then jumps rapidly to the next constant value, the temperature interval between these successive flats being $12.2° \pm 0.5°C$. and the energy interval being about 0.01 electron volt, which is considerably smaller than the energy of thermal agitation.

Because the effect was thought to be dependent mainly on the presence of the OH groups, the simplest substance of this type, namely water, was next examined. The measurements were made at intervals of 2°C. to 1.8°C. in the temperature range of 6°C. to 75°C., and they gave clear evidence for the existence of similar steps in the case of water. However, the temperature interval between the steps is $6.2° \pm 0.5°C$., which is almost exactly half that for ethylene glycol, and the energy intervals are found to decrease progressively with increasing temperature. In order to clear up this anomaly, further experiments with ethylene glycol, using a measuring interval of 1°C. are being carried out, and it appears that each of the previously observed steps now splits up into two very sharp steps.

A further series of investigations has also been started on ethyl alcohol, which possesses only one hydroxyl group. Some preliminary results have been obtained on alcohol containing 6% water (i.e. rectified spirits) and also on alcohol containing about 12% water. No steps are observed here in the inter-molecular activation energy, but instead a nearly sinusoidal variation with a period of 10°C. for rectified spirits and 9°C. for alcohol containg 12% water is found. More acurate measurements on the water-ethyl alcohol system and on pure water are in progress.

Publications: (1) The Relationship between Viscosity and Molecular Structure. Part III. Accurate Measurement of the Temperature Dependence of the Activation Energy of Viscous Flow in Ethylene Glycol by A. Rauf and M. M. Qurashi, Pakistan J. Sci. Ind. Research, 2, 30 (1959).

(2) The Relationship between Viscosity and Molecular Structure. Part IV. Observation of Energy Level Structure in the Inter-molecular Potential Energy of Activation for Viscous Flow of Water by M. M. Qurashi and A. K. M. Ahsanullah, Pakistan J. Sci. Ind. Research, 3, 106 (1960).

(3) The Relationship between Viscosity and Molecular Structure. Part V. Preliminary Activation Energy Measurements on Aqueous Ethyl Alcohol by M. M. Qurashi, A. M. Chowdhry and H. Ahmad, Pakistan J. Sci. Ind. Research, 3, 116 (1960).

(4) The Relationship between Viscosity and Molecular Structure. Part VI. Evidence for Fine Structure of the Activation Energy of Viscous Flow in Ethylene Glycol by A. K. M. Ahsanullah, S. Rahmat Ali and M. M. Qurashi, Pakistan J. Sci. Ind. Research, 3, 201 (1960).

(5). Study of the Influence of Long and Short chain Phenolic Additives on the Viscosity of Mineral Oils: The experiments carried out on mixture of mineral oils with bhilawanol and its methyl derivatives had yielded the following relationship between the viscosity ν of the two constituents and the viscosity depression $\triangle\nu$ produced on mixing them, viz.

$$\log (\triangle\nu) = 1 + (1.36 \pm 0.02) \times \log \nu$$

$$\text{i.e. } \log (\triangle\nu / \nu^{1.36}) = K, \qquad \ldots\ldots(1)$$

with $K \underset{\sim}{=} -0.5$. It was therefore considered of interest to examine the allyl series, i.e. allyl catechol, allyl phenol and allyl benzene. The measurements on mixtures of allyl phenol with a mineral oil blend of the same viscosity ($\nu \sim$ 3 centistokes), showed a viscosity depression of the order of 0.3 centistokes, which roughly agrees with the above law. The experiments on mixtures of oil with allyl benzene also showed a similar depression in the viscosity with an optimum at about 45% allyl benzene, thus confirming that the phenomenon under study is not merely a consequence of the presence of the phenolic OH groups, but is of a more general occurrence.

The experiments using mixtures of oil with allyl catechol were still more interesting, because the two constituents form a partially miscible system at ordinary temperatures, the critical solution temperature being as high as 120°C. This produces a profound effect on the viscosity-concentration graphs, in that the usual depression effect has superimposed upon it a large anomalous increase in viscosity in the middle portion of the concentration range, so that the complete graph shows a central maximum with two minima, one on either side. By taking a series of measurements at various temperatures, in the range of 60°C., to 180°C., it was possible to extrapolate the values of the initial depression to 40°C., for comparison with allyl phenol and benzene. These values show that for the allyl series of compounds, the equation (1) holds, but with a slightly higher value of K.

It has further been found that, the value of the above-mentioned anomalous rise in viscosity for a given composition depends very markedly on the temperature, and this observation has been followed up mathematically

in order to find an explanation for the phenomenon on the basis of Einstein's equation for suspensions and using the concept of incipient polymerization of the two phases into large molecular aggregates at temperatures several degrees C. above the solubility temperatures. This approach leads to the possibility of estimating the sizes of these aggregates, and a figure of about 70 molecules has been obtained for the size of the aggregates just above the solubility temperature. The foregoing experiments have been followed up by others designed to measure the variation of the viscosity depression $\triangle\nu$ with temperature in the case of mixtures of bhilawanol and of allyl phenol with appropriate mineral oils. A mathematical relationship has again been found applicable in this case, which can be interpretted with the help of the foregoing measurements on the anomalous viscosity increase caused by the proximity of the miscibility temperature.

Publications: (1) Studies on the Influence of Long-chain Phenolic Additives on the Viscosity of Mineral Oils. Part IV. Temperature Variation of the Viscosity Depression in Mixtures of Bhilawanol and Allyl Phenol with Mineral Oils, by Z. Rahman, S. Malik and M.M. Qurashi, Pakistan J. Sci. Ind. Research, 2, 229 (1959).

(2) The Influence of Phenolic Additives on the Viscosity of Mineral Oils. Part V. Phenomena Occurring in the Proximity of the Miscibility Limit in Mixture of Allyl Catechol and Mineral Nil, by Z. Rahman and M. M. Qurashi, Pakistan J. Sci. Ind. Research, 3, 23 (1960).

6. Infrared Studies of the Relation between Hydrogen Bond Absorption and Viscosity Depression: The series of experiments just mentioned above have shown that a definite relationship exists between the viscosity depression, $\triangle\nu$, produced in the mixture and the actual viscosity ν of each of its constituents In order to elucidate the precise nature of the dependence of this depression $\triangle\nu$ on the nature of the molecule and the degree of association, it was considered desirable to undertake a quantitative infrared study of the OH and H-bond absorption in the 3 micron region, using mixtures containing various concentrations of the phenolic compounds, bhilawanol and allyl phenol. The absorbancies have been obtained from expanded traces taken on a Leitz Recording Double-beam Infrared Spectrophotometer using cells of two thicknesses, 0.083 mm for small concentrations of the phenolic component and 0.033 mm for larger concentrations. These traces were graphically resolved into the sharp OH peak and broad H-bond peak, and it was found that, while the OH peak height is proportional to the concentration of the phenolic components (as expected), the H-bond peak height is proportional to 1.4 th power of this concentration.

In order to compare the infra-red measurements with the previously obtained viscosity data, a theoretical approach has been developed, which leads to the equation:

$$\frac{\Delta\nu}{\nu} = K_2 \times \frac{C}{100}\left\{1 - \frac{a_c/C}{a_{100}/100}\right\}, \qquad \ldots\ldots(2)$$

Where a_c represents the H-bond peak absorbance for a mixture containing C% by weight of the phenolic compound, and K_2 is a non-dimensional constant. The graphs for $\Delta\nu/\nu$ calculated with $K = 0.080$ from equation (2) agree to $\pm$ 6% with those deduced from the viscosity measurements. It is hoped to study other phenolic compounds inorder to further test the validity of the above theory and to elucidate the significance of the index 1.4 noted above for the variation of the H-bond peak height.

Publications: (1) Infrared Absorption Study of the Relation between Viscosity and Inter-molecular Hydrogen Bond Formation for Solutions of Phenolic Compounds in Oil. Part I. Solutions of Bhilawanol in Mineral Oil by M. M. Qurashi and S. H. Zaidi, Pakistan J. Sci. Ind. Research, 2, 21 (1959).

(2) Ditto. Part II. Solutions of Allyl Phenol in Mineral oil by S. H. Zaidi and M. M. Qurashi, Pakistan J. Sci. Ind. Research, 3, 31 (1960)

7. Study of the Insulation Resistance and Dielectric properties of Insulating Materials: In the course of investigations on the properties of certain insulating varnishes and some rubberoid type of materials (jutoid) developed in other Divisions of the Central laboratories, it was considered worthwhile to study the electrical resistance of these materials at different voltages right upto the electrical breakdown limit. A simple alternating current apparatus for this purpose was accordingly set up using a 25 kilovolt transformer, a kilovoltmeter and a voltmeter connected across a 20,000 Ohm resistor for measuring the current through the insulating sample, which was placed between a 3″ diameter disc and 1½″ diameter cylinder as in British Specifications.

With this simple set up, the resistances of the insulating varnishes and jutoid mentioned above, as well as of a number of other insulating materials have measured and plotted as functions of the applied electrical field. It appears that in many classes of materials, the resistance drops uniformly with increasing applied voltage, and it is possible to predict the value of the breakdown field by extrapolating the resistance versus voltage graph to

zero resistance and multiplying the resulting field by a factor of the order of 0.8.

Further work is being undertaken to investigate the nature of the voltage dependence of electrical conductance in a variety of insulating materials, and there are indications of the existence of two definite classes, in one of which the conductance is closely proportional to applied voltage, except in the vicinity of electrical breakdown.

Project Associates: M. M. Qurashi, S. Nurul Ahmed, Khursheed Husain, Fakhruddin and Gazimuddin.

8. DEVELOPMENT OF RAPID PHYSICAL METHODS FOR DETERMINING THE OIL CONTENT OF A SINGLE COTTONSEED : The rapid estimation of the oil content of a single cottonseed is a matter of considerable importance to studies in cotton breeding relating to the development of high oil content varieties. If a simple method for this estimation can be evolved, it should be possible quickly to examine a few seeds from an individual plant and use the rest for propagation in breeding experiments. A further elaboration of such a micro method would be to develop a non-destructive technique that does not impair the viability of the seed.

This problem was referred to the C. S. I. R., Central Laboratories by the Cotton Research Committee, and so far three methods, each based on a different principle, have been studied by us: (i) expression of the oil (under pressure) between a set of filter papers followed by measurement of the area of the oil spot so produced, (ii) measurement of the density of the oil seed after dehulling, and (iii) measurement of the electrical constants of the oil seed under several different conditions. So far the first approach has yielded the best results, while work on the third is also well advanced.

(i) A thorough examination of the method based on oil expression has been made, and the effects of crushing load, size and quality of filter paper, the water content of the kernel and the wetness of the paper have all been studied quantitatively, and it is found that good results can be obtained with a crushing load of 7 tons on a sandwich of four medium-grade filter-paper disc of diameter 5 to 10 cm., using a relative humidity of about 80%, corresponding to 10% moisture in the cottonseed kernel. A technique has been developed using an Effective Area of Oil Spot (=Total area of spot -/0.55 $\times$ area of crushed kernel), which is independent of the water content of the kernel. These measurements have been correlated with microsoxhlet extraction experiments on several sampled lots of 10 kernels

of two different varieties of cottonseeds, and a conversion factor of 0.054 ± 0.001 mg per sq. mm. has been obtained for converting the effective area of the oil spot into milligrams of oil, when working with 5.5 cm. diameter discs of Greens 401 filter paper.

(ii) An experimental study of the specific gravities of the kernels of some varieties of cottonseed kernels has shown a broad statistical frequency distribution, extending nearly from 0.8 to 1.2, with in some cases a pronounced bimodal character, i.e., two peaks one below and the other above 1.0. While this feature rules out the possibility of using the density measurement as a means of estimating the oil constant, it has been found that a very marked correlation exists between these peaks and corresponding peaks in the mass-distribution. This is being studied further.

(iii) Examination of the electrical constants of the cottonseeds has proved more fruitful for our present purpose, and it has been found possible (a) to measure the capacity and conductance response for 10 to 20 kernels on a standard Marconi Universal A. C. Bridge operating at 1000 cycles per second, and (b) to develop an extension circuit for this type of bridge, whereby a sensitive external Galvanometer used with a 5 % out-of-balance setting of the bridge dial produces a 20-fold increase in sensitivity, which enables the capacity response of single cottonseed kernels to be recorded. The effect of relative humidity and water-content of the kernel on the capacity has been investigated, and an optimum value for the relative humidity is determined at 75%, corresponding to about 6% water on weight of the kernel. At this humidity, the method is expected theoretically to give the maximum sensitivity.

Publications: (1) The Development of Rapid Methods for the Estimation of Oil Content of Single Cottonseeds. Part I. An Oil-expression Technique, by S. Nurul Ahmad and M. M. Qurashi, Pakistan J. Sci. Ind. Research, 2, 13 (1959).

(2) The Development of Rapid Methods for the Estimation of the Oil Content of Single Cottonseeds. Part II. A Preliminary Examination of Some Non-destructive Methods by S. Hilal Ahmad and M. M. Qurashi, Pakistan J. Sci. Ind. Research, 2, 223 (1959).

(3) The Development of Rapid Methods for the Estimation of Oil Content of a Single Cottonseed. Part III. Critical Examination of the Techinque Based on Oil Expression by M. M. Qurashi, N. Ahmad and S. A. K. Lodhi, Pakistan J. Sci. Ind. Research, 3, 101 (1960).

(4) The Development of Rapid Methods for Estimation of Oil Content of a Single Cottonseed. Part IV. The Electrical Response of a Single Cottonseed at 1000 Cycles Per Second by A. K. Bhuiya, S. H. Ahmad and M. M. Qurashi, Pakistan J. Sci. Ind. Research, 3, 172 (1960).

(5) Investigations on the Statistical Frequency Distribution of Some Physical Characteristics of Cottonseed Kernels by S. Hilal Ahmad and M. M. Qurashi, Pakistan J. Sci. Ind. Research, 3, 231 (1960).

9. STUDIES IN THE MANUFACTURE OF COMPONENTS FOR ELECTRONICS INDUSTRIES : A programme of work has been taken up on the possibilities of manufacturing electrical components like carbon resistors, carbon potentiometers, paper condensers and electrolytic condensers. A considerable measure of success has been obtained with these items, and the conditions laid down in British Standard Specifications have generally been obtained.

(a) For the production of electrolytic condensers, it is first necessary to have exceedingly thin and uniform insulating oxide coatings electrodeposited on aluminium foil, and the optimum conditions for this have been studied. Satisfactory Condensers of about 100 microfarads were prepared. The work is still in progress.

Project Associates: A. K. M. Ahsannullah, M. H. Osmani, M. Afroz Khan, M. A. Beg and M. Wajahat Hussain. .

(b) Some progress has also been made with the construction of carbon resistors. The work is being carried out in collaboration with the paints and plastic division, and it has been found possible to obtain good stability with several specimen resistors.

Project associates:- A. K. Bhuiya and Nisar Hassan Burney.

INORGANIC AND ANALYTICAL CHEMISTRY

1. Reduction of Kalabagh iron ore (containing ferruginous clay) with Sui gas: The X-ray structure analysis of Kalabagh iron ore carried out in the Physics Division of the Council revealed that a representative sample of the ore containing 34% iron consists mainly of four important iron bearing minerals:

	Corrected values
Limonite ($Fe_2O_3H_2O.nH_2O$)	7 %
Hematite (Fe_2O_3)	14 %
Siderite ($FeCo_3$)	22 %
Chamosite $3(Fe,Mg)O.Al_2O_3\ 2SiO_2.nH_2O$	30 %

Pakistan does not possess cheap coal of high calorific value, e.g., coal dust—an unavoidable by-product of the coal mining industry—therefore the Krupp-Renn-process does not apply to the Pakistan ore which is practically identical with the low grade iron ore of Germany for which the Krupp-Renn-process specially was developed during the first world war. Consequently it was thought feasible to reduce the Kalabagh iron ore with Sui gas. As it could be expected, the oxides and the carbonate in the ore could easily be reduced to metallic iron, while the complex iron aluminium-magnesium-silicate, the Chamosite, remained unaffected. Subsequent studies with the view to decomposing Chamosite by roasting in air into iron compounds susceptible to reduction have been successfully carried out. The results of the roasting process were controlled by X-ray analysis because it was not possible to determine chemically met tallic iron side by side with its oxides or other iron compounds. It revealed that the characteristic lines of Chamosite disappeared completely from the X-ray pattern only when roasting had been carried out at temperatures not lower than 950° to 1000° C. The second important information gained from these experiments was that the roasting had to be done in a strong current of air. Only then is Fe_2O_3 formed while with lesser amounts of oxygen Fe_3O_4 and a much more complex X-ray pattern was found. An iron ore roasted that way can now be reduced completely with Sui gas at the same temperature of 950°C. to 1000°C. When the reduction is carried out in a strong current of Sui gas one gets—after magnetic separation—sponge iron of 95% iron content.

These laboratory experiments have to be followed by Pilot Plant investigations in a fluidised bed oven where sintering is expected to be reduced to a minimum. Sui gas may also at first be converted by the well known reaction with steam $CH_4 + H_20 \rightarrow Co + 3H_2$ furnishing a mixture of hydrogen and carbon monoxide. Uptil now only high grade oxidic iron ores have been processed by gas reduction in a fluidised bed. By the above-mentioned process the low grade iron ores specially those containing ferruginous clay can be expected to be processable also in countries where no cheap coal is available.

The patent applications put up in the Commonwealth Countries, U. S. A., Germany and Japan did not meet any objection principally adverse to out claims.

Publication: Pakistan J. Sci. and Ind. Research, 2, 4, October 1959. Reduction of Kalabagh Iron Ore (Containing Ferruginous Clay) with Sui Gas.

Project Associates: Syed Ishtiaq Ali, Mushtaq Ismail and George Hahn in collaboration with Latif Ahmad, Sadrul Hassan Razvi and M.M. Qurashi.

Patent Application: Pakistan and other Commonwealth Countries, U. S. A., Germany and Japan.

2. Sodium Silicate: A special type of furnace for small scale production of sodium silicate to study the effect of silica alkali ratio on viscosity of sodium silicate has been designed.

Large amounts of sodium silicate are being manufactured in the country for use in Soap Industries and as water proofing agent for cement. There is also a demand for adhesives based on sodium silicate. There is also a demand for adhesives based on sodium silicate. The sodium silicate manufacturers at present encounter a number of difficulties which they have been referring to us from time to time. On inspection of a number of concerns it was found they suffered from the following defects.

1) Furnaces were ill designed in most of the cases.
2) No adequate arrangement for preventing heat losses are provided.
3) No control on the quality of raw material is carried out which results in products of varied nature.
4) There are difficulties in dissolving the silicate.
5) The product is not colourless.
6) It shows variable viscosity etc.

It was therefore decided to set up a small experimental furnace. The hearth is designed to have a crucible of 10″ dia. so that for every new batch a different crucible can be used. Study of different batches were made separ-

ately. These crucibles were also made in the laboratory from fire clay. A suitable die was designed and fabricated by us.

It is proposed to prepare different silica soda ratio sodium silicate and study the viscosity changes for ultimate utilization in the adhesive compounds. A separate study of various types of sand used by the industry is being made with a view to decrease its iron content and various impurities in a simple and economic way.

The work on the investigation of the raw materials and the various manufactured silicates is nearing completion. Work on the rest of the project is progressing.

Project Associates: Riaz Ali Shah, M. Aslam, S. Tehzib-ul-Hassan, and Tahir Raza.

3. REDUCTION OF ANTIMONY OXIDE (Sb_2O_3) TO ANTIMONY METAL: The Steel Corporation of Pakistan Ltd., have antimony sulphide mines in Chitral where they convert it into Sb_2O_3. They had erected a furnace for the reduction of the oxide to antimony metal at their premises at Landhi. The furnace which was designed and constructed by foreign expert was not functioning properly and not only was it difficult to melt the charge but also the yield of the metal was only 25% as against the expected 70%. There was considerable loss of the charge at the time of starting the furnace, considerable amount being lost through the doors provided in the sides of the furnace. Other difficulties experienced by the operators included extreme difficulty in taking out the mother metal through the tapping hole provided for this purpose. The slag and the metal got solidified, the side of the furnace had to be broken and the metal dug out. It was also reported that the slag was not free-flowing but was very thick, the metal remained embeded in it, and its separation from the slag was not affected.

The Steel Corporation was on the point of pulling down the furnace the erection of which cost them about Rs. 1 lakh in addition as fees paid to the foreign expert. At this stage the firm approached us to find out whether it was possible to remove the defects emunerated above, without dismantling the furnace.

After an exhaustive investigation of the furnace all the mistakes in its construction were found out, and it was found possible to modify this furnace so that the melting process could be carried out with satisfactory result.

This work took us about 10 months. The firm is now working in that newly-designed furnace with satisfactory results.

GENERAL ORGANIC CHEMISTRY

1. Determination of nitrogen in organic compounds without distillation. Part I—Determination of ammonical nitrogen in organic compounds: The distillation in the macro-determination of ammonical nitrogen in organic compuonds by Kjeldahl method has been eliminated. After having digested the sample in sulphuric acid with potassium sulphate and mercuric sulphate, the acid is neutralised. The resulting ammonium sulphate is treated with an excess of hypochlorite in presence of potassium bromide. An excess of arsenite is then added to backtitrant with hypochlorite using Bordeaux indicator.

Publication: Pakistan J. Sci. Research, January 1960.

Project Associates: R.A. Shah. M.K. Bhatty, and Muhammad Ashraf.

Part II. Determination of nitrogen in nitro, nitroso and azo compounds: A Kjeldahl method for the determination of nitrogen in nitro, nitroos and azo compounds without resorting to the usual distillation step has been evolved. These compounds are reduced with glucose to amino compounds which yield ammonium sulphate on digestion with sulphuric acid. The ammonium sulphate is determined titrimetrically after hypobromite oxidatiou. The accuracy of the method is 0.2%.

Publication: Pakistan J. Sci. Research 3, 3, July 1961.

Project Associates: Riaz Ali Shah, M. K. Bhatty, Muhammad Ashraf.

2. Micro determination of chlorine in organic compounds: The objective of the research was the development of a single rapid and complete procedure for analysing all types of organic halogen and sulphur compounds without the use of any special apparatus.

A method for the analysis of organic chloro compounds is presented. The sodium metal in a nickel capsule sealed inside a borosilicate glass is heated at a moderately elevated temperature. After the destruction of the residual sodium the solution is filtered and passed through a column of cationic exchange resin (the resin is previously purified by treatment with HCl + alcohol) mixture.

$$Na\ OH + NaCl + 2HZ/H_2O + 2NaZ + HCl.$$

The hydrochloric acid produced is then titrated with standard sodium hydroxide solution.

The technique is rapid and has many advantages. The accuracy of the method is ± 0.3 % absolute.

Project Associates : Riaz Ali Shah, Mohammad Irfan Khan and M. K. Bhatty.

3. DESIGN OF LABORATORY TYPES RECUPERATIVE GAS FIRED FURNACE DIAGRAM : A furnace was needed so that small melting operations could be carried out easily in the laboratory where an adequate supply of gas may be available. The furnace can take up a crucible of 3" X 4" size and attain a temperature of 1000°C. on gas air mixture.

ANALYTICAL SECTION (MICRO)

During the past years the section suffered a set back three of trained technicians left for improving their qualifications. New staff was recruited and the training was started again. For more than nine months no work could be undertaken since no combustion tubes for the micro furnaces were available due to the lack of foreign currency at our disposal. Inspite of these handicaps about 900 analyses were performed for various sections. The section is now in a position to undertake C, H, N, (Dumas) S, I, Br, Cl- OCH_3, molecular weight , N(Kjeldahl) determinations provided that the necessary spare parts are always available. A rigorous programme of training is in progress in order to achieve a higher standard of accuracy and reliability.

BIOCHEMICAL RESEARCH

1. Fish Flours: One of the cheapest sources of animal protein in Pakistan is the shark meat and that of some other fishes. Of these shark meat is the most difficult to deodourize, being perhaps the only meat that contains urea. In order to remove the urea, it is systematically putrefied along with salt, dried under the sun and finally exported to countries of South East Asia where its smell is apparently tolerated. A process has now been worked out in these laboratories to deodourize shark meat. Fresh meat is minced, washed and finally treated with Soya bean powder, which contains urease. Urea is thus almost completely got rid of. The meat is now centrifuged quickly, and dried by means a hot air blower at a temperature of about 50°C. When less than 10% moisture is left, it is defatted by extracting it first with a "solvent oil", then with Petroleum ether or the like to remove the "solvent oil", and finally dried again by blowing hot dry air. A patent has been applied for and a paper is being prepared for publication. It appears from personal discussions with experts that nowhere in Asia is shark meat flour being made.

A sample of the processed flour was submitted to F. A. O., Rome, who favourably reported as to its biological value. According to Dender's method, the digestibility is 99% and the nett protein utilization 61. Good fish flours usually have a nett protein utilization between 60-75. The process has reached the stage of a pilot plant trial to estimate the cost of manufacture.

Flour from the meat of sardines has also been prepared and is found to give a better product than shark meat: not only was it easily freed of its fishy odour but such flour contained the flavour of meat soap. The flesh of typical bony fishes has no urea and is easier to process into "fish flour".

Project Associates: S. Abdul Haq and S. Mahdihassan.

(2) Guar Seed Flour: Seeds of *Cyamopsis psoralioidis*, locally known as Guar, serve as the source of guar gum. The seed covers or splits contain the gum and these alone are used in gum manufacture, the kernel or the real seed. Rich in protein, being a by-product, the local cattle consume it happily. When exported to foreign countries, it is found that it causes European cattle to suffer from diarrhea. This problem is being studied.

The amino-acid make up of Guar seed protein has been compared with that of Soya bean, and the study has yielded interesting findings. Fresh guar beans are regularly used as human food, so that guar seed flour should be able to function in this country as a source of protein, just as soya bean does in the Far East, and work in this direction has been taken up. Guar seeds have a special odour of their own, and after several experiments, Guar meal or the by-porduct of the gum industry has been successfully processed and freed of its odour. It is hoped to patenting this process of deodourizing guar seed meal for converting it into a "flour" for human consumption. It should present a better source of protein than cotton seed flour as well as flour from ground nut cake. A preliminary report of study on guar protein has been submitted for publication.

Project Associates: Miss Shakila Siddiqui, Abdul Rahman Memon, S. Abdul Haq and S. Mahdihassan.

(3) ANTIANEMIC PREPARATIONS OF IRON AND OF TRACE ELEMENTS: There is a widespread occurrence of intestinal infection mostly of amoebic origin. The symptoms are very vague, but anemia resulting from disturbed digestion is quite common. When such patients are given iron orally, the intestine is not able to tolerate ionizable iron like ferrous sulphate or even iron gluconate. There is no such high quality oral preparation of any make on the market. Iron Saccharate to be used orally has been prepared in these Laboratories, and is found good enough for intravenous use. It is being tested clinically by a hospital in Karachi.

Publication: S. T. Ali Naqvi, Siraj Ahmad Rizvi and S. Mahdihassan. Arzneimittel-Forschung. November 1959.

Complexes of Trace Elements: Trace elements play a definite role in curing anemia as they form part of several enzyme systems and as such are indispensable. Here again the aim is to make complexes of metals with carbohydrates such that they should be fit enough for intravenous use when they will automatically be good enough for oral use. Among such complexes, that of Manganese has been made most successfully. Others made include the following metals: Cobalt, Molybdenum, Copper, Nickel, Vanadium and Cadmimum. Of these Nickel is one so far not known to partake in any enzyme system, but it is a metal normally present in the liver. Like Cadmium, which has only recently been found, Nickel may also prove in the future to be a metal in the nucleus of some useful enzyme. A paper is being submitted for publication.

Project Associates: S. Abdul Bari, Rasheed Bakhsh Qadri, Saiyed Ali Hasnain and S. Mahdihassan.

(4) REVITAMINIZATION OF POLISHED RICE: Rice grains, after being polished or parboiled, lose most of the vitamins. From rice polishings, concentrates rich in Vit-B. Complex were recovered and used for replacing them on the grain. During the process, the grain becomes brittle, so that when such revitaminized rice is cooked, it appears to consits not of whole grains but of a mass of broken rice grains, if not even of a granular paste. Some parts of the process require more the application of an art than of science, but it is hoped to bring it to the stage where it can be patented.

Project Associates: S. Abdul Haq and S. Mahdihassan.

(5) SHARK SKIN AND FISH GLUE: In practice it is cheaper to buy the whole shark and after taking the liver to dispose off the meat and skin, rather than to buy the liver alone. The meat can be processed as fish flour, which still leaves shark skin to be exploited. While the Tannery Section is co-operating to convert shark skin into leather, it is noteworthy that fish skins and fragments of shark skins are ideal for glue manufacture and experiments have therefore been initiated with this view. The Division of Chemical Engineering is co-operating in studying this problem.

(6) HISTORY OF ISLAMIC CHEMISTRY: It is invariably believed that alchemy is the art of gold making and further that the Arabs acquired the name "Kimiya" from the Greeks. On careful analysis, however, the reverse seems to be the case. The Greek word transliterated as "Chemeia" and is actually the result of a coptic transliteration into Modern-Greek which actually sounds "Kimiya". The pagan Arabs before Islam traded with Alexandria and introduced Alchemy first among the Pagan Copts. What is recognized as Greek alchemy was really the Coptic or Alexandrian alchemy and it is shown that the first Alexandrians were neither Greeks nor Christians.

The Copts were initiated into alchemy which primarily was a cult of immortality, in theory a branch of mysticism, in practice akin to magic. It aimed at converting matter into spirit and imparting to every substance a sublime from which will then remain as such for ever. Thus to confer "immortality" on a metal was to make it gold. This in turn became a drug of immortality.

Publications: S. Mahdihassan: (1) The Probable Origin of Kekule's Symbol of the Benzene Ring-"Scientia", 1960. (2) Alchemy in the Light of its Names in Arabic, Sanskrit and Greek. "Janus" 1961.

(7) STUDIES ON ABRUS PRECATORIUS LINN: *Abrus precatorius*, or Jequirity as it is called in English, Gunja in Sanskrit, Ratti in Urdu and

Kunch in Bengali, is a perennial twiner belonging to the natural order Leguminosae. The seeds are usually bright scarlet, with a black spot on the top and are highly polished. There are three varieties of the seeds - scarlet, white and black.

The seeds of Jequirity have been reported to contain two toxic factors a toxalbumin and a toxglobulin. Although no quantitative work has been carried out so far, the globulin has been reported to be more toxic than albumin.

By fractional precipitation with ammonium sulphate it has now been possible to isolate a fraction which is far more active than hitherto reported. The ultra-violet spectrum of this fraction resembles that of a typical protein, with a minimum at 250 m and maximum at 278 m. The taoxin, which we have called "ABRIN" is completely deactivated by momentarily heating it to 80°C. It is haemagglutinating and is toxic towards albino mice in amounts as small as 4 microgram. Twelve hours after injection, the animal shows signs of drowsiness, the eyes are only half open and general movements become very restricted. The rate of respiration increases considerably, a state which continues till the animal dies.

Post Mortem Finding; The site of indection becomes oedematus and ecchymosed. Widespread punctiform haemorrhages are noticed on the various internal organs e.g. lungs, kindneys, and pericardium, liver, spleen and peritoneum. The blood remains fluid for quite a long time.

Toxicity Towards other Laboratory Animals : The toxin has also been tried against four other laboratory animals, i.e. rat, rabbit, guinea pig and cat; the rat appears to be the most sensitive of them all. The studies on toxicity were carried out in the Pharmocological Section.

Project Associtates: A.H. Khan, Mumtaz A. Hashmi and M. Ikhlas Khan.

PESTICIDE RESEARCH

Pesticide research is a continuous warfare against man's competitors, and is carried out on countless fronts with operations ranging in scope from those of the house to the global efforts of the Food and Agriculture Organisation and the World Health Organization of the United Nations. Pakistan is an agricultural country and most of the present pesticides used to control injurious pests to agriculture and harmful to human health are imported from foreign countries. Keeping this in view, the pesticide research programme is in progress in the Central Laboratories of the P. C. S. I. R. Under this programme, indeginous raw meterials are in use to develop pesticides, which should be quick and efficient to control pest; harmless both to plants and higher animals; as easy as possible to apply and cheap withal.

In Central Laboratories, the pesticide research is covering the following classical disciplines:-

1. Insecticide Research.
2. Fungicide Research.
3. Microbiology Research..
4. Phytotoxicity Research.
5. Pesticide Formulations.
6. Rearing of Pests..

Insecticide Research

(*a*) MAKEROLENE AS A LARVISIDE:

Project Associates: S. H. Ashrafi and S. M. Murtuza

Pakistan is facing the great problem of Malaria Control and mosquito is one of the main causes of it. Consequently, efforts have been made to find whether Makerolene will be effective to control mosquito larvae. Standard experiments have been designed and glass dishes of 18.5 cm. diameter and 6 cm. in height were used for this purpose. These dishes were filled with one and half litres of tap water. 20 mosquito larvae were released in the dish through a glass tube of 3.5 cm. diameter and 6 cm. in length. Dilutions of various concentrations of Makerolene were made in acetone (standard diluent). After exposing the larvae for 30 minutes, they were transfered into fresh water. The results of Makerolene have been compared with Heptachlor, Aldrin, Chlordane and DDT. Heptachlor, Aldrin and Chlordane

were found superior to DDT and Makerolene. Makerolene gave better results than DDT, when doses of lethal concentration for 95% under experiments were compared.

(*b*) MAKEROLENE AS A CONTACT INSECTICIDE:

Project Associates: S. H. Ashrafi and M. A. Quddus Khan.

The first step before testing Makerolene as a contact insecticide was to assemble a micrometer-syringe with a needle of 25 Gaus. By the help of this apparatus the measured droplets of the insecticide were put on the thoracic region of insects. This method is widely known as Topical Application method. The test insects were cockroaches and house flies. The mesosternum of the cockroaches was used as a spot for putting the measured quantity of the insecticide. Readings were taken after 24 hours and LD_{50} was calculated in micrograms per cockroach per 24 hours. The results have been compared with DDT and other Chlorinated insecticides, imported from foreign countries. Interesting results have been obtained due to the toxicity of Makerolene which was found to be superior to DDT against cockroaches. Tests against house flies are also in progress.

(*c*) MAKEROLENE AS A FUMIGANT:

Project Associates: S. H. Ashrafi and Sultan Ali.

Pakistan Government is spending several lakhs of rupees for the purchase of fumigants in order to save the stored grains from insects which are causing great damage to our stored food. Therefore a research programme was drawn to find whether Makerolene can be used as a fumigant. The following methods have been used to perform the tests.

(*i*) FILTER PAPER METHOD: Different concentrations of Makerolene were prepared in acetone. One ml. of each of the solutions was spread on a filter paper of size no. (*i*) 9 cm, Genuine Whatman. After drying them for 24 hours, five flour beetles were released and the rate of mortality was observed after 24 and 48 hours. It was found that 5% of Makerolene gave 50% mortality upto 10 days.

(*ii*) FUMIGATION CHAMBER METHOD: In order to find the fumigant effect more precisely an aspirator of 12 litres capacity was used as a fumigant chamber. The neck and the bottom of the aspirator were tightly corked to prevent the leakage of the fumes. By the help of the delivery tube, 25 beetles were hanged in a microcage. The fumes were maintained for 30

minutes. Exactly after 30 minutes the beetles were taken out to be released in petri dishes, and the rate of mortality was counted after 24 and 48 hours. These experiments have clearly shown that Makerolene may be used as a fumigant to control the stored grain pests. Further experiments are in progress.

Fungicide Research

MAKEROLENE AS A FUNGICIDE:

Project Associates : S. H. Ashrafi and M. Ghayasuddin.

Before testing the fungicidal action of Makerolene, it was necessary to isolate the different species of fungi and to grow them on culture media. Several species of fungi were isolated from the soil and *Aspergillus niger* was selected for the test.

The pure strains of *Rhizoctonia bataticula, Fusarium Spp.* and *Alternaria* were also selected for testing. Makerolene checked the growth of all the four fungi. It was found that Makerolene can also be used to control Fungi.

Microbiology Research

Project Associates : S. H. Ashrafi and M. Ghayasuddin.

Pakistan and many other countries like Moracco, Tunis, Egypt, Iraq, Iran and India are facing a great problem of damages rendered by desert locust. These countries under FAO programme are spending several lakhs of rupees to control and exterminate locust. Keeping this in view, the work on the isolation of bacteria found in desert locust was started. The main purpose of this research project is to investigate the bacteria harmful to desert locust. The bacteria have been isolated from the abdominal as well as surface washing of locust. Out of these bacteria, *Serratia marcescens* (chromogenic) and *Staphylococcus aureus* are of great value, from the view point of locust control. They have been reported to kill insects. At present we are trying to isolate these bacteria in pure strains and after studying their pathogenicity, they will be used to control locust on laboratory scale. In this project we are also collaborating with the Locust Control Section of Plant Protection Department, Government of Pakistan.

Besides the above mentioned work, we are also collaborating with the Department of Fisheries and are testing the sample of fish meal,prepared

by the Central Fisheries Department, for a pathogenic enteric bacterium of genus *Salmonella* (Fish meal is exported to West Germany and according to the W. German Government regulations, fish meal should be free from *Salmonella Typhosa* organisms, the causative agent to typhoid).

Phytotoxicity Research

Project Associates : S. H. Ashrafi and M. Tasnif

It is necessary to find the phytotoxic effects of an insecticide before using it in the field, because we do not want to control the insect at the cost of destroying the crops and other vegetations due to high phytotoxicity. Therefore, experiments were designed to find the phytotoxic effect of Makerolene and it was discovered that 6% Makerolene gave different phytotoxic effects on different plants. 2% Makerolene did not show any phytotoxic effect, while 3% showed less phytotoxic effect. Other workers have reported low phytotoxic effect of other chlorinated insecticides on different plants under normal dosages. In our laboratory experiments we also found that normal dosage (3% in acetone) of Heptachlor, Dieldrin, Chlordane, BHC, DDT and Makerolene gave low phytotoxic effects against bean plants. But Makerolene was found less phytotoxic than Aldrin, Dieldrin, BHC, Chlordane and DDT against 4- week old bean plants.

Mammalian Toxicity

Project Associates : S. H. Ashrafi and M. A. Quddus Khan

Since insecticides are used at places where they can easily come into contact with human beings and animals and thus always endanger their lives due to accumulated lethal effects of the insecticides, it was found necessary to investigate the Mammalian Toxicity of Makerolene and it was found that 3,000 mg/K are required for oral lethal dose (LD_{50}) to kill 50% population under experiment, while 800 mg/K of DDT are required to get oral LD_{50} of rat.

Pesticide Formulations

(*a*) Dust Diluents:

Project Associates: S. H. Ashrafi, M. Tasnif and M. Ghayasuddin.

Under this project, the indigenous innert dusts of French chalk, Multani Mitti and Gypsum are under experimentation to be used as dust diluents

and carrier for insecticides. The main purpose of this research is to find a suitable dust and economically cheap, for diluting the technical grades of pesticides and thus to save lot of money which is spent every year to buy already formulated insecticides from foreign countries.

(*b*) Emulsifiable Concentrates:

Efforts have been made to prepare emulsifiable concentrates containing the maximum percentage of insecticide. It was also necessary that such a kind of emulsifiable concentrate should make a stable emulsion by adding water directly and there must be no need of mechanical shaking. For this kind of work two emulsifiers were prepared in the P.C.S.I.R. and their results were compared with the two emulsifiers, Teepol 710 and Nonidet P-40 supplied by Messrs. Burmah Shell Oil Storage & Distributing Company of Pakistan Limited. It was found that the same percentages of emulsifiable concentrate prepared by mixing P.C.S.I.R. emulsifier were estable than the emulsifiable concentrate prepared by emulsifiers supplied by Messrs. Burmah Shell, Karachi.

In our formulation section we have been successful in making emulsifiable concentrate of DDT from 25—70%. The work is still in progress, and will be reported after its completion.

Rearing of Pests

Project Associates: S.H. Ashrafi, A.A. Chima, Ishtiaq Ali Khan and Ajaz Ali.

Insect rearing is one of the most important programmes of Pesticide resarch. At present we are trying to standardise the rearing of house flies, cockroaches, mosquitoes, flour beetles, bed bugs and termites. It is helping the research work very much because now we are using the insects of known age, sex and vigour.

INVESTIGATION OF INDIGENOUS MEDICINAL PLANTS

1. *Centaurea Behen Compositae.* Part II: The compounds referred to in Part I of this investigation received from petrol ether extract could not be attributed to the reported therapeutic efficacy of this plant. The present investigation of the alcohol extract revealed the presence of a glucoside in .03% by weight of fresh roots. (Colourless globules from tetrahydrofuran, charring at 260° to 285°C. $[\alpha]_D^{30} = 48°$ $C_{33-35}H_{54-60}O_6$. On hydrolysis with sulphuric acid it furnished a sterol m.p. 133—134° (from alcohol) $[\alpha]_D^{25} = -31°$. $C_{27-28}H_{44-48}O$ and glucose identified by paper chromatography. Attempts to isolate even very small amounts of alkaloid were not successful. Finally the roots already being exhaustively extracted with petrol ether and alcohol were extracted with water when 38% inulin, by weight of the fresh roots, were received and properly identified by hydrolysis and paper chromatography. The stimulant action of aqueous decocts of the roots used in indigenous systems of medicine are therefore obviously due to that high content of Inulin perhaps supported by very minute quantities of a so far unknown alkaloid. Inulin is of commercial importance. A patent application is therefore being put up for the production of inulin from that cheap indigenous plant material.

2. Investigation of a by-product of Quetta Ephedrine Factory: The Ephedrine species processed in Quetta are extracted with benzene after being made alkaline. The alkaloids are removed from that benzene extract by hydrochloric acid. The remaining benzene solution freed from benzene leaves a grease like blackish-green material in quantities (several tons a month) which justify a proper investigation with the view to its further industrial utilization, especially as all the sterols must be concentrated in that grease. The usefullness of one of them for the cortizone synthesis had to be checked. The results of the present investigation are given in Fig. I. Of industrial importance are 36% of a mixture of a copious amount of palmitic acid besdies a smaller amount a stearic acid both easily available from the grease. There is only one sterol present in 3% by weight of the grease which is not easy to isolate. It melts at 134—35°C. and is optically active. Carrying only one oxygen it offers no prospects of being a starting material for cortizone. Most interesting is an alcohol present in 15% by weight of the grease. It melts at 80°C. shows $(\alpha)_D^{30} = +15°$ and has a molecular formula within

the range of C_{24-28} $H_{48-58}O$. So far it could not be identified with any alcohol. Its investigation is continued. Furthermore a hydrocarbon with an unbranched chain of at least 31 C—atoms could be isolated.

Publications: Pakistan Journal of Scientific and Industrial Research Vol. 2, No. 4 October, 1959.

Investigation of a By-product of Ephedrine Processing by Marker Alkaloids, Quetta. by Naseem Uddin Siddiqui and George Hahn.

3. STUDIES ON *Lavandula Stoechas Linn.* (*Labiatae*) PART I: According to the books on Indian Materia Medica this plant is widely used by indigenous Hakeems to cure chest affections and to releave biliousness. In the present first part of the work the petrol ether extract has been properly investigated.

The following substances have been isolated.

(1) *The Lavandula Sterol C.*—Present in 2.8% of the dried plant (without roots) melts 268—270°C. (Dec.) shows $(\alpha)_D^{27} = +67.2°$ (2% tetrahydrofuran) and has a molecular formula of C_{26} $H_{40-44}O$. Only one of the oxygens belongs to a hydroxyl group because only one acetyl group enters the molecule on acetylation. The other two oxygen atoms belong most probably to a lactone grouping because alcoholic alkali forms a difficultly soluble alkali salt of an acid. Unfortunately the amount of this very interesting sterol which might be a starting material for cortizone differs very much with the harvest conditions of the plant. It is well known that these constituents vary with the age of the plant as well as with the harvest time. In spring it might be completely different as against autumn. Lacking plantation facilities this could not be cleared while this sterol separates in large quantities from the petrol ether extract the residuing material was subjected to absorption analysis on alumina where the following substances could be isolated.

(2) *Lavandula Hydrocarbon.*—Probably n-nonacosane m.p. 61—63°C. moleculer formula C_{27-29} H_{50-60}.

(3) *d-Campher:*—Present in at least.031% of the plant material which offers no prospects for industrial utilisation.

(4) *Lavandula Sterol A and B.*—Both are present in minor quantities and do not offer prospects of being starting materials for cortizone.

Sterol (*a*) melts at 204—5°C. shows $(L)_D^{29} = +39.6°$ and fits in the narrow range of $C_{22\text{-}23}\ H_{30\text{-}34}O$ Sterol (*b*) melts at 135—36°C. Its rotation is $(\propto)\ {}_D^{24} = 23.5°$ and its molecular formula may be between $C_{22\text{-}24}\ H_{36\text{-}40}O$. Both sterols give positive Liebermann and Digotonin tests.

RAUWOLFIA ALKALOIDS

(1) CONSTITUENTS OF *Rauwolfia vomitoria* OBTAINED FROM AN EXPERIMENTAL PLANTATION IN EAST PAKISTAN: Complexes corresponding to serpajmaline, ajmalexeine and resajmaline as isolated from *Rauwolfia serpentina* have now been isolated from *Rauwolfia vomitoria* grown in an experimental plantation in East Pakistan. The complex corresponding to serpajmaline was found to be a strong hypotensive agent in dogs and also had antifibrillant action on the isolated heart of rabbit. The chemical constituents of these complexes have been examined and a serpajmaline corresponding complex was found to contain alstonine as the major alkaloidal constituent together with ajmaline and serpentinin. The other two complexes gave reserpine, ajmaline and serposterol. The extracts were found to contain maltose, sucrose, glucose and mannose as the sugar constituents.

Projecct Associates: Salimuzzaman Siddiqui and M. Manzoor-i-Khuda.

(2) CONSTITUENTS OF *Saxifraga ciliata :* The plant is native to the northern region of Pakistan and is locally known as *Zakhme Hayat.* The roots of this plant are used locally as astringent, tonic and stomachic. No chemical investigation has so far been reported in the literature about the plant. Some Indian workers have chemically investigated "Zakhmehayat" from Kashmir. But this plant (*Cissampeles pareira Lim.*) though it has the same local name is different from the one we have been working on.

A bitter crystalline product m.p. 152°C. and 224°C. has been isolated from this plant. Though many of the physical and chemical properties of the substance are similar to that of Bergenin its optical rotation value is different.

Some of the physical and chemical properties are given below: -

Properties.	**Bitter from S. Ciliata.**	**Bergenin.**
M. P.	152—3°C. and 244°C.	148—9°C. and 234°C.
$[\alpha]_D$	—70°at 22°C. (1%EtOH)	—37.25° (1% EtOH).
Crystalline form	Cubes from water.	various.

Solubility	Soluble in hot water, hot ethanol, hot methanol and hot ethyl acetate. Insoluble in ether, benzene, ethanol, petroleum ether, chloroform and acetone.	Soluble in water and ethanol.
Bitterness.	Detectable upto a dilution of 1 in 10,000 (Water).	—
Mol. Formula	$C_{14}H_{16}O_9 . H_2O$	$C_{14}H_{16}O_9 . H_2O$
Functional groups	6-OH & 1-MeO & a lactone.	Same.
Derivative	Penta-acetate m.p. 209-10°C: $[\alpha]_D^{22}$—96° (in 1% $CHCl_3$).	Penta-acetate m.p. 199—203°C.

The extracts also gave a resin acid and on paper two sugars namely glucose and fructose could be identified.

Project Associates: Salimuzzaman Siddiqui and M. Manzoor-i-Khuda.

BUILDING MATERIALS

1. Production of Cellular Light Weight (Ordinary) Burnt Bricks: So far only two methods are known to be used for the production of light weight burnt bricks: (*i*) Incorporation of Combustible organic matter like saw dust, coal dust, etc., which will burn off when the bricks are fired in kilns. (*ii*) Incorporation of certain clays, shales or slates, like vermiculite, kyanite, etc., which on heating to the point of incipient fusion expand or 'bloat' owing to the generation of the gases within the mass of the material. None of these methods however impart a proper cellular structure to the product.

A new process based on the utilisation of foaming or air-entraining agents has been evolved, whereby it has been possible to make light-weight cellular burnt bricks of any desired density ranging from 20 to 100-lbs. per cu. ft. These bricks have better a thermal insulation than cellular concrete of corresponding densities, and better compressive and very high flexural strengths as compared to cellular concrete made from neat cement.

Patent coverage is being obtained.

Project Associates : Tehzibul Hasan, Mohammad Aslam, Riaz Ali Shah and Hasan Imam.

2. Utilisation of 'Balcrete' (C.S.I.R. Foaming Agent)

(*a*) Production of neat cement cellular concrete: This investigation deals with the preparation and physical properties of moist-cured cellular concrete based on neat cement. Methods of production based on (*i*) high speed stirrers and (*ii*) ordinary non-tilting drum concrete mixer, using 'Balcrete' C. S. I. R. Foaming Agent have been successfully developed. The ratio of rate of production to mixer capacity is 2.6-2.8, which is very satisfactory since the highest ratio reported using assembly line techniques is 3.0. Compressive and flexural strengths and thermal conductivity values have been determined for cellular concrete of varying densities. The ratio of flexural to compressive strength varies from 0.12 to 0.20, the ratio increasing with increase in density. This contrasts with the results given in the literature for autoclaved cellular concrete, in which case the ratio decreases with the increase in density.

The cellular concrete produced has adequate strength for (*i*) structural use at densities above 60 lbs. per cu.ft. (*ii*) for partition walls at densities between 40-60 lbs. per cu.ft. A publication has been prepared on the basis of the above findings.

Project Associates: Mohammad Aslam, S. Tehzibul Hasan, Mubarak Ahmad and M. Jehangir.

(*b*) AGGREGATE CELLULAR CONCRETES: Air-entrained concrete was originally developed in the U.S.A. for its frost resisting qualities, which is of small importance to this country. However, other properties of both fresh and hardened concrete are also affected by air-entraining, and this aspect is of considerable interest to the local building industry. The influence of air-entraining on fresh concrete is beneficial, because it improves workability and cohesion, and also facilitates compacting and finishing.

The effect of using various proportion of 'Balcrete' for the production of 1:1:5; 1:2:4; 1:9; 1:12 cement concrete has been investigated. The results of the concrete is considerably increased by 'Balcrete' if used in the proportion of 0.1 - 0.25% by weight of cement.

Further work is in progress.

Project Associates: S. Tehzibul Hasan and Mohammad Aslam.

3. MARBLE SUBSTITUTES: It has been observed that certain locally available minerals can be processed to give marble type of materials. Although the flexural strength of the products is comparable with natural marble found in the country, certain difficulties have been encountered in getting uniform results. This has made it necessary to study in some detail the chemical reactions taking place in this process. This investigation is in hand.

Project Associates: Mohammad Aslam, S. Tehzibul Hasan, Riaz Ali Shah and S. K. Zaidi.

4. LIGHT WEIGHT INSULATING REFRACTORY BRICKS: The usual method for the manufacture of porous brick by mixing it with carbonaceous materials such as anthracite, coke lignite, cork, sawdust, seeds, etc., has many limitations. The proportion of combustible matter that can be added will depend upon the binding power of the clay, so that the porosity obtainable with a particular type of clay is limited, and the control of the porosity will become very difficult with this process.

A process has been developed at the Central Laboratories, which is independent of these limitations as no carbonaceous matter is used. Added advantages are that a sufficient amount of grog can be incorporated and the porosity can be controlled quite accurately according to the requirements. The size of the pores is small, which gives a much greater insulating power.

These bricks can be used as 'hot face' insulating bricks without the protective coating of a dense fire-brick, especially in furnances where cleaner conditions prevail.

Project Associates: Riaz Ali Shah, Mohammad Aslam, Tehzibul Hasan and Hasan Imam.

5. Jute-sticks and wood chip boards: This project has been taken in hand to utilise the waste jute sticks, i.e. stripped stalks, which are abundantly available in East Pakistan, for the preparation of different qualities of boards. The similar problem of wood chip boards has also been investigated. Preliminary results on this project are very encouraging and the Jute-stick boards give a naturally beautiful design and finish.

Project Associates: Mohammad Aslam, Ashhad Mehdi, Ali Hussain and Zahuruddin.

6. Roof slabs in low-Cost Houses: The large scale construction of low-cost houses is of vital significance especially with reference to refugee rehabilitation. Roofs have been paid much attention as these involve the use of mild steel, an imported material at present, and the expenditure on this item is about 50% of the total cost of construction. Economies have previously been effected by minimizing the use of steel and cement, either by reducing the thickness of roof slab or laying plain concrete tiles over precast reinforced concrete battens. An attempt has now been made by us to design and test a roof that can cut down the cost without affecting the comfort in the houses and at the same time does not need any extra water-proofing layer. Use has been made of the flexural strength of the concrete to reduce the quantity of steel from approximately 170 lbs. to about 34 lbs for the construction of a single room of $10'-0'' \times 11'-0''$ inside dimensions, without any change in the quantity of concrete.

Project Associate: S. Tehzibul Hasan.

CHEMICAL ENGINEERING AND PILOT PLANT SECTION

The Engineering and Pilot Plant Section has been mainly associated with the development of the Council's processes and has been providing consultation service and technical aid to industrialists to whom these processes have been leased out. Development of certain projects to the stage of Pilot production is undertaken with a view to studying their economics and ascertaining the most suitable size and design of the plant for industrial exploitation. In certain cases production on a small scale has also been undertaken, partly to fulfil the immediate needs of the country and thus to conserve foreign exchange and partly to establish the quality of these products. The completion of these projects has been rendered possible through setting up of pilot plants based on imported equipments, modified to specific requirements, and in some cases through the design and fabrication of the entire equipment in the Engineering Section.

The work of the section may be divided into the following heads:—

I. Projects of the Council in the Production stage.

II. Progress of leased out projects under guidance of the Engineering Section.

III. Projects under development and investigation.

IV. Design and Fabrication of Plants and Equipments.

V. Pilot Production.

VI. Applied Research investigations.

VII. General (Maintenance, repairs, services, etc.)

A report on the work of the Engineering and Pilot Plant Section during the period under review is given below:

I. PROJECTS OF COUNCIL IN THE PRODUCTION STAGE:

The Engineering Section is responsible for providing consultation service and technical aid to industrialists to whom Council's processes have been leased out,

Production on a commercial scale, based on completed projects leased out to industrialists has already been started on the following:—

(*i*) *Jutoid waterproof matting:* The Jutoid Matting plant designed and fabricated for experimental purposes for making waterproof matting on which more than 1,00,000 sq. ft. of matting was manufactured by this Section on a Pilot scale, has been utilised by Messrs. Hyesons Ltd., Karachi, who are now producing the said waterproof matting. They have produced more than 6,25,000 sq. ft. of Jutoid Matting on this very plant under the guidance of the Council. The plant has a production capacity of 8,000 to 10,000 sq. ft. per day. Patent for the plant has been accepted in Pakistan as well as in India. (Pakistan Patent No. 109346 dated June, 1960, and Indian Patent No. 65866 dated November, 1960. Improvement in and relating to a plant for production of waterproof sheets. Abdul Hamid Chotani and S. M. Ishaq Ali.)

(*ii*) *Gas Generating Plant:* Under the guidance of this Section, Messrs. Consolidated Products Company, Karachi, have started the production of Gas Generating Plants with an annual production capacity of 80 to 1000 plants.

A total of 38 units have already been fabricated by this section and supplied to different Scientific Institutions.

This has already been covered under Pakistan Patent No. 107507 of 29th May, 1957 and Indian Patent No. 60783 of 14th June, 1957.

(*iii*) *Cemto Water Proofing Compound:* In collaboration with the Paints and Plastics Division the Engineering Section has developed this process to pilot plant stage and produced about 9,000 lbs. of this compound, which was supplied to consumers.

The process has been leased out to Messrs. Pakistan Water proofing Co., Karachi. The Engineering Section has designed and fabricated a number of machines for the manufacture of "Cemto", and supplied them to Messrs. Pakistan Water proofing Co., this has enabled the firm to go into production without any loss of time.

The plant has a production capacity of upto 500 lbs. of Cemto per day.

Some of the machines supplied to Messrs. Pakistan Water proofing Co. have novel patentable features for which patent coverage is being obtained.

II. PROGRESS OF PROJECTS LEASED OUT UNDER THE GUIDANCE OF THE ENGINEERING SECTION:

Some of the projects of the Council which have already been leased out to industrialists are given due guidance in respect of:-

(*a*) Selection of plant and machinery

(*b*) Designs of machines and equipments which are to be locally fabricated

(*c*) Flow sheets of different operations

(*d*) Lay out plans

(*e*) Demonstrations of the respective processes and

(*f*) Erection and operation of machines etc.

An account of such projects is given below:

(*i*) *Shark Liver Oil:* Messrs. Pakistan Vitamin Products, Karachi to whom this project has been leased out are keeping close contact with the Engineering Section, who, in collaboration and consultation with the Bio-Chemical Research Division are giving due guidance to set up the industry in the very near future.

(*ii*) *Insulating Boards*: Flow sheets and other details of this process have been suplied to Messrs. Kashmir Development Corporation, Karachi to whom this project has been leased out for commercial exploitation. Demonstrations of the process have already been given to the proprietors and their Engineers. Details of the plants and their availability has also been suggested. Experiments leading to Pilot production of insulating boards $24'' \times 18'' \times \frac{1}{2}$ is continued for close study of the project as an industry.

(*iii*) *Fountain Pen ink:* Detailed specifications of machines and plants required for this process developed by the Physical Research Division, have been worked out and supplied with flow sheets etc. to Messrs. General Stationers, Ltd., Karachi to whom this process has been leased out.

III. PROJECTS UNDER DEVELOPMENT AND INVESTIGATION:

(*i*) *Kumbhi leaves for Biri Industry:-* Details of this project have been worked out with respect to its plant and machinery in collaboration with the East Regional Laboratories, Dacca, who have evolved the processing of Kumbhi leaves for Biri industry. A Pilot plant was set up in the East Regional Laboratories, Dacca, by the Engineering Section for further experiments and study of the different operations before designing and fabricating an industrial plant. After coming to certain conclusions, an industrial plant has been designed and is under fabrication in the Engineering Section. The plant includes a special drying machine with series of rollers and end-less belts with various adjustments. The machine incorporates some novel patentable features. Patent coverage is being obtained.

(*ii*) *Fish Flour:-* The Biochemical Research Division has evolved a process for producing protein-rich meal from fish meat. The Engineering Section, in collaboration with the Biochemical Research Division, has set up a pilot plant in order to develop the project for industrial exploitation. Small scale production with certain modifications in the various operations is still continued resulting in better quality and colour of the fish meal. Investigations and study regarding the design of an industrial plant for the manufacture of fish flour are also being carried out simultaneously.

(*iii*) *Chlorination of Gasoline for insecticides:-* A pilot plant for production of Insecticides has been set up for chlorination of Gasoline for field tests. The capacity of the plant is 15 to 20 litres per batch. Modifications in the process as well as in the plant are continued.

(*iv*) *Denaturant for Methylated Spirit:-* A pilot plant has been set up for making Denaturant for Methylated spirit from rubber scrap. A suitable plant has also been designed. fabricated and set up for testing the product.

(*v*) *A Plant for the production of Wood Preservative:-* The Engineering Section has designed andfabricated a plant for the production of wood preservative in collaboration with the Paints and Plastics and Building Materials Research Divisions. The Plant has a capacity of 100 lbs. of raw meterial per charge.

V. DESIGN AND FABRICATION OF PLANTS, EQUIPMENTS AND OTHER MACHINES:

The development on the design and fabrication of plants and equipments in the Engineering Section has been in relation to the specific needs of the various Divisions of the Cetral and the Regional Laboratories. Descriptions of some of these are given below:

(1) *Autoclave-60 lbs. per sq. inch:-* An autoclave of 85 cu. in. capacity has been designed and fabricated specially to meet the specific needs of the Biochemical Research Division. Under the maximum gauge pressure of 60 lbs./sq. in. it is able to give a temperature upto 307°F. Pressure is raised within 15 minutes and can be maintained for long periods without charging.

Patent coverage is being obtained.

(2) *Autoclave 200 lbs. per sq. inch:-* An autoclave has been designed and fabricated for the Building Materials Research Division, with a capacity of 1000 cu. in. The autoclave is adequately equipped with all necessary fittings and mountings. Several fool-proof and safety devices are also provided. The autoclave will give temperatures upto 388°F. under absolute pressure of 215 lbs./sq. in. Temperature and pressure can be maintained for periods varying from 24 to 48 hours without re-charging.

Patent coverage is being obtained.

(3) *Basket type Centrifuge:-* A centrifugal machine powered with a 3.5 HP motor has been designed and fabricated. The filtering medium is filter cloth or lighter fabric as required. The machine is suitable for hydro-extractions and has solved various problems which otherwise involve intricate operations. The capacity of the machine is about 40 lbs. per charge.

Patent coverage is being obtained.

(4) *Basket Centrifuge Laboratory Type:-* A very simple and compact centrifugal machine has been designed and fabricated for unit operations with a capacity of about 5 lbs. per batch. The basket is suitably mounted direct on the motor. Copper or brass sieving cloth, filter cloth or any other fabric can be fitted and used as filtering medium. The machine can be operated in any direction without any risk.

Patent coverage is being obtained.

(5) *Rotary Sieving Machine*:- A Rotary Sieving Machine has been designed and fabricated which can be fitted with sieving cloth of required mesh. The rotating drum of the machine is made to a horizontal shape for efficient sieving. Besides circular motion the drum also vibrates with a mechanical device. Adequate adjustment are provided for varying the frequency and intensity of the vibrations.

Patent coverage is being obtained.

(6) *Micro-distillation Apparatus*. A compact and efficient apparatus has been designed and fabricated for the Micro-analytical Labs. for micro-distillation purposes. The apparatus is very simple and can handle and operate 8 Micro-distillation Units at a time with electric heating arrangements, and cooling condensers suitably mounted on a single stand. The apparatus can also be used for extraction purposes.

Patent coverage is being obtained.

(7) *Insecticide Powders Mixing Machine*. A mixing machine has been designed and fabricated for the Biological Evaluation Section for effectively mixing insecticides with powders. The machine is provided with adjustments for various sizes of mixing bottles. It is made to work three to four mixing bottles at a time.

(8) *Mixing Machine* (*Industrial Size*): A fully mechanized industrial size mixing machine for powders has been designed and fabricated especially for use in production of "Cemto' water proofing compound. The capacity of the machine is upto 5 cwt. per batch.

The machine is patentable due to its novel features providing accelerate mixing.

Patent coverage is being obtained.

(9) *Leather Dyeing Machine*: The Engineering Section has designed and fabricated a machine for effective dyeing of leather samples for testing purposes. The machine carries six glass jars at a time and turns them upside down at a required rate. This machine ensures uniform dyeing of the samples in the minimum possible time.

Patent coverage is being obtained.

(10) *Reverbratory Kiln:* A small Reverberatory Kiln of 250 cu. in. capacity has been designed and fabricated for reactions of solids under varied conditions in the presence of different gases for use by the Inorganic Section of the Chemical Research Division.

(11) *Distilled Water Plant:* A plant has been designed and fabricated for producing distilled water for industrial use. The capacity of the plant is more than one gallon per hour. Due to its novel fool-proof and safety arrangements it can be used all the 24 hours without a full time operator, so that the plant can be used upto a capacity of 20-24 gallons per day. The plant is gas or oil fired. Ordinary kerosine oil stoves also give good results.

Application for a patent has been filed.

(12) *Distillation Column with Heating Chamber:* A distillation plant has designed and fabricated and set up by the Engineering Section for use in the Pilot Plant Section for distillation of liquids under various temperatures. Main features of the plant are:

(*a*) A hot chamber in which the glass vessel containing the liquid is enclosed, providing suitable openings for thermometer and hot flues etc.

(*b*) An electrically operated enclosed hot plate.

(*c*) A sight hole and slots with electric lighting system to give a full view of the vessel.

(*d*) A closely fitted condenser and receiving vessels.

The entire plant is mounted on a single robust stand with a base occupying floor space of less than 3 sq. ft. The vessel, heater, condenser, receivers etc. are fitted vertically on the stand, and are fully adjustable. The heater can be moved vertically to give different ranges of temperatures for various products. The hot chamber does not allow any refluxing of the material, which otherwise is difficult to control. The capacity of the plant is $1\frac{1}{2}$ litres per batch.

The apparatus was specially needed for separation of products under the required range of temperature from crude denaturant produced from rubber scrap and also for testing the product after mixing it with alcohol. It is also very useful for separating fractions from chlorinated gasoline.

(13) *Bubble flow meters:* A bubble flow meter has been designed and fabricated in collaboration with the Pharmacology Section, for determining the rate of blood flow, particularly in heart - lung preparations. The apparatus comprises a micro-glass pump with suction and delivery valves and is operated by a solenoid, controlled by a push button switch. The travel of the plunger of the pump is adjustable so that the required size of bubble can be released.

A Micro-bubble Flow Meter has also been designed and fabricated with a non-ferrous mealllic pump, without suction and delivery valves. Suction and delivery is controlled by slots and grooves provided in the plunger. This pump is also operated by solenoid.

Patent coverage is being obtained for these two units.

(14) *Respiration recording apparatus:* The Engineering Section in collaboration with the Pharmacology Section has designed and fabricated a respiration recording apparatus. The apparatus is very compact. The points of contact can be adjusted from 0 to $\frac{1}{2}''$ as required for different animals.

Patent coverage is being obtained.

(15) *Micro-respiration recording apparatus:* This apparatus is specially designed and fabricated to meet the requirements of recording rate of respiration of small animals like frogs and rats etc. in which the movement and force of the moving part of the body during respiration is very little. This unit has adjustments from 0 to .125 inches with very close adjustments of the points of contact, as well as the whole apparatus to the body of the animal.

(16) *Decorticating Machine:* The Engineering Section is designing and fabricating a decorticating machine for removing fibre from leaves of certain agricultural plants.

(17) *Peat Carbonisation Plant:* A Peat Carbonisation Plant has been designed and is under fabrication for the East Regional Laboratories, Dacca. The plant has a capacity of 1 cwt. of peat per batch and has to rotate at low speed within a built-in-furnace fired with coal, gas or wood.

(18) *Diaphragm pump:* A diaphragm pump has been designed and fabricated for compressed air as well as for vacuum. This pump

is under trial. It will replace complicated and costly imported units, due to its simplicity in design, efficient working and other novel features.

Patent coverage is being obtained.

(19) *Rotary Kiln for Cement etc.:* A rotary kiln 8 ft. × 18" dia. for cement and other products has been designed and is under fabrication by the Engineering Section in collaboration with the Building Materials Research Division. The Kiln will work as a Pilot Plant for various products. It has the special features of necessary adjustments for feeding slurries or solids of different natures and treating them under varied conditions.

(20) *Viscometer:* A Viscometer has been designed and is under fabrication with additional speed indicators, close adjustments and measurement devices etc. The Viscometer is designed for the Physical Research Division.

Patent coverage is being obtained.

(21) *Sago Making Plant:* A plant for making sago has been designed for East Regional Laboratories, Dacca and is under fabrication. The plant will consist of two machines. One machine will turn the starchy material into granules, while the other will roll them to the required shape.

Patent coverage is being obtained.

(22) *Foam Generating Plant:* A plant has been designed and fabricated by the Engineering Section for generating foam in cement with the help of Foaming Agent developed by the Paints and Plastics, Chemical and Building Materials Research Divisions. The plant is portable and powered with 10 H.P. Motor.

The capacity of the plant is about 1 cwt. of aggregate per batch and the time of operation varies from 3 to 5 minutes.

Patent coverage is being obtained.

(23) *Pneumetic Separator:* The Engineering Section has designed and fabricated a Pneumetic Separator for separating sands, powders and other materials. The machine has been very effectively

used for separating guar seed shells or hulls and guar seeds from shredded guar seeds. The machine can be used for mineral dressing under the great advantage of dry and quick processing.

Patent coverage is being obtained.

(24) *Insulating Tape Making Plant* 18″ : A plant has been designed and is under fabrication for producing insulating tapes on semi-industrial scales. The plant comprises an impregnating unit under controlled conditions, with squeezing devices, a drying chamber and cutting and rolling machines. The machine will take fabric of 18″ width.

Patent coverage is being obtained.

(25) *Insulating tape apparatus* 1″ : A Laboratory size insulating tape coating machine is designed and is under fabrication to take a tape of 1″ width.

(26) *Insulating tape apparatus* 4″: Another insulating tape coating apparatus is fabricated to take fabrics of 4″ width.

(27) *Conditioned Reflex Producing Apparatus:* This apparatus has been designed and fabricated in collaboration with the Pharmacology Section of the Central Laboratories for producing conditioned reflex in small animals like mice and rats. The apparatus consists of transparent chamber with necessary openings, the base of which is provided with a net work of live wires connected to variable voltage through a transformer and an electric bell with a push button switch. A wooden bar fitted to the top of the chamber is provided for the animal under training or test to escape the electric shock when the bell rings.

Patent coverage is being obtained.

(28) *Drying and flaking machine:* A machine has been designed and is under fabrication for dehydrating materials. This is specially designed for making powder or flakes of "Haleem," a multi-purpose food. The main roller is to be electrically heated under varied temperature conditions. This machine is also to be used for calendering and coating applied for.

Patent coverage is being obtained.

(29) *Micrometer Least Count .0001"*: The Engineering Section has designed and is fabricating a micrometer to measure a hundredth part of a thousandth of an inch. The micrometer is almost as compact as a common micrometer, but the performance widely differs from it. In the existing micrometers the ratio of the movement of the thimble and the spindle is 1 1, while in this micrometer this ratio is 10:1.

Patent coverage is being obtained.

V. PILOT PRODUCTION:

During the period under review the Engineering and Pilot Plant Section has been undertaking Pilot Production of the following:

(1) "Jutoid" Water-proof matting.
(2) "Cemto" water proofing compound.
(3) Gas Generating Plants.
(4) Air Entraining Agent.
(5) Fish Flour.

VI. APPLIED RESEARCH INVESTIGATIONS:

Work is being taken in hand in the following:—

(*a*) Modifications and improvements in kerosine oil and electric heaters and pressure stove etc.

(*b*) Manufacture of slate pencils.
(*c*) Plant for the manufacture of slate pencils.
(*d*) Apparatus for testing slate pencils, comprising:-

i) Machine for testing breaking strength of pencil.
ii) Machine for giving impressions on slate.
iii) Impression testing machine.
iv) Impression removing machine.
v) Machine for testing abrasive effect of pencil on slate.
vi) Machine for ascertaining wear and tear of slate pencil.

VII. GENERAL: (MAINTENANCE, REPAIRS, SERVICES ETC.)

1. Maintenance and repairs of all the mechanical and electrical installations in the laboratories and all the existing instruments and apparatus.

2. Production of laboratory glass-ware and training of glass blowers.

3. Petty civil works, including new constructions and modifications to existing building.

FUEL RESEARCH

1. Studies in the Utilization of Raw Gasoline Obtained as a By Product on the Gasification of Makerwal Coal at Daudkhel. Experiments for the Refining (Especially Sulphur Reduction) of the Gasoline with a view to preparing a suitable Motor Fuel: It has been ealier reported that by passing the raw gasoline in gasified state along with stream and Sui gas (possibly only acting as a carrier gas) at 350°C. over iron oxide (at first Kalabagh-iron-ore was used) as a catalyst, followed by a treatment with small amounts of chemicals (2—vol. % of conc. H_2SO_4, do of 5% NaOH Solution, and 2 vol. % of a solution of 15% methylalcoholic NaOH) and re-distillation, an almost colourless refined product is obtained, from which the mercaptans as well as the free, elemental sulphur the most harmful aggressive forms of sulfur in a motor fuel—have been completely removed. The total sulphur, in the raw material 3.5%, could be reduced to 2.0%, with a yield of 75% wt; further reduction by chemical means brought it down to 1—4%, of course, at the cost of the yield. Most of the gum-forming constituents were also removed to give the refined product colour stability for a number of weeks. Of course, a sample standing over a year exposed to air and light, showed a darker colour and also some sedimentation of particles due to some polymerisation of olefines still going on.

With these properties, the refined gasoline does not correspond to the specifications of motor fuels imported or produced from crude oil in Pakistan. It will require further studies, e.g. the application of hydrogen which might take part in the removal of hydrogen sulfide during the catalytic treatment, and/or more effective catalysts, and/or to work under a higher pressure instead of at about 20 to 50 mm Hg-column as now in the catalytic plant.

Project Associates: H. von Hoessle, Tofail Ahmed Bhuiyan. Mohammad Nizamuddin, Mohammad Nabiullah.

2. Superheated Steam Treatment of Pakistan Coals at Subcarbonisation—Temperatures. Experiments carried out with the small Laboratory Plant. During the period under review quite a number of experiments for further studies of the Steam Treatment Process according to Pakistan Patents No. 105—108 and 105—109, using the small laboratory plant for a charge of 2 kg. or 1 kg. of powdered Makerwal Coal, have been done. The purpose of these experiments was:—

(*i*) To obtain exact results in respect of the possible upgrading of Makerwal Coal (by reducing the volatile matter, enhancing the fixed carbon, on the removal of sulphur from the residue of this treatment) in comparison with the results obtainable at the LURGI Coal Processing Pilot -Plant.

(*ii*) To investigate and quantitatively determine the various liquid and gaseous products distilled off under the influence of the superheated steam.

(*iii*) To collect more of the steam-volatile neutral 3rd fraction (Makerol) for further studies of its insecticidal properties at the Entomology Section.

From a limited quantity of Makerwal Coal (supplied in 1958) on the average 8% of resinous material comprising all the three fractions including neutral, acidic, and basic constituents was recovered. Among the gaseous products carbon dioxide, hydrogen sulphide, Carbonoxysulphide, carbon disulphide as well as sulphurtrioxide(traces)were estimated. The sulphur content of the resinous material was also determined. The sulphur evolved in volatile from (i.e. the sum of all sulphur distilled off the coal) was found in good accordance with the reduction of the sulphur in the residue after treatment. In this way from two sides a sulphur balance could be established.

Project Associates: H. von Hoessle, M. Naseem Ahmed, Ibrahim Khan, Iqbal Ahmed Khan and for the Entomology Tests: Shahid Ashrafi.

In connection with these experiments it may also be mentioned that work has been started on the investigation of changes to be assumed in the ash composition of original and steam treated coal to explain the very interesting observation that part of the residue becomes paramagnetic.

Project Associates: M. Naseem Ahmed, M. Z. Raza.

3. Experiments carried out in the LURGI Coal Processing Pilot Plant. Considerable improvements were required and have been made to the LURGI apparatus and equipment. These comprise improved insulation, new feeding system for the coal, wider dimensioning of all lines for the distillation product and for the cooling water, design and construction of adequate condensers, switching over from furnace oil to Sui gas heating of the boiler and superheater, design and construction of a screw extractor to withdraw samples from the fluidized bed during a run of the plant and to collect the treated coal after completion of the experiment. These were completed by May 1959, and it may

be stated that the plant can be run with the best possible performance so for as the actual operation is concerned, within the range (max. 200 kg. of steam per hour to be superheated upto 450°C.) for which the plant was constructed. To reduce the quantity of steam and particularly, of the condensate, it was found possible to run the plant at 150 kg/h of superheated steam, but, at lower rates (e.g. 80 to 100 kg/h) the fluidized system gets entirely disturbed.

In the course of pilot—scale trials in the desired upgrading of coal and the recovery of resinous material, the following facts have been observed.

(*i*) In about 5 hours' batchtype processing of Makerwal coal (100 kg. at a time) the properties of the residue obtainable undergo almost the same changes as was found for the experiments in 1959/60 in the small laboratory plant. Thus from 100 parts of coal, about 75 to 80 parts of residue are obtained with the volatile matter reduced from 44% to around 30% (dry basis), while the fixed carbon has been increased from about 39 to 52% (dry basis). The desulphurisation of the coal is in the range of 30 to max. 40%. This means that from 100 g. coal (dry basis) containing 6 g. total sulphur, when 30% of the original sulfurgoes into the volatile products (resins and gases), we get 75 g. residue containing 6.0-1.8=4.2 g. total sulphur. It cannot be denied that in view of the big effort of energy and time consumed the reduction of volatile matter is not satisfactory.

(*ii*) The yield of resinous material (4 to 5%) can not be completely compared to that of the laboratory plant (about 8%), since the Makerwal coal processed in the LURGI—plant has been supplied in 1955 and is definitely inferior in quality to that of 1958 obtained in drums and used in the small laboratory plant. The lower yield is however not as serious as the relatively inferior quality of the resinous material. The reasons for these differences are that the methods of processing of the coal at the laboratory plant and at the large-size pilot plant are considerably different from each other. In the laboratory plant, 94% of the heat consumed is supplied by gas combustion from outside the retort and only 6% by the steam entering at a temperature of 180°C. In LURGI—plant, steam superheated to 450°C. maximum temperature and entering the fluidized system at a temperature of 370°C. is the only source of heat. This circumstance makes it necessary to operate the plant with a quantity of steam sufficient for warming up the coal and maintaining it at a level of 325 to 350°C. For 100 kg. of coal, 150/h of steam are just adequate to maintain the desired temperature. However, this quantity of steam is far too high for proper fluidization, and the enormous speed produced by the large volume of superheated steam results in carrying over about 10% of the coal, mostly in form of fine dust, to the mul-

ticlone and condensation system. Only part of this undersirable material carried over is collected in the multiclone. The result is that the resinous material obtained, after having passed the condensation, is a black, sticky emulsion containing 15% dust and 40% water. To remove both, extraction of the raw resins with solvent oil has been found a tolerably good means of separation of the impurities from the resinous material. In this way, at least 55% of the crude materials are recovered in a refined form, whereas to submit the raw resins to a second steam distilation, as proposed for the recovery of Makerol, and actually executed with the small amounts of resins in the experiments at the laboratory plant, gives only 9% of oil after separation from the large quantity of condensate by means of ether. Centrifugation of the raw resins at 80°C. does not give satisfactory results in respect of the separation of dust and water. However, this operation might be successful when applied to hot solvent oil extract.

(*iii*) It has been observed that during fluidization there is a tendency of the coal mass to get classified according to the specific gravity, i e. coal of higher density due to a higher ash content mainly caused by pyrites accumulates near the screen. A more serious effect of the fluidization is the fact that, due to the violent motion of the coal particles, a disintegration of the coal of finer size happens. So, dust is formed whereas the coal introduced to the process was before hand classified to a size of—8 + 72 mesh B.S.S. This necessary classification of the coal for the processing in the plant renders 50% of the coal as supplied from the mine unsuitable for treatment in a fluidized bed. This is mainly responsible for the contamination of the raw resins and renders the operation unsuitable for the friable Pakistan coals.

(*iv*) The low yield of resinous material obtainable in the large size plant partly has to be attributed to the circumstance that the light volatile constituents escape along with the permanent gases inspite of 210 sq.ft. of cooling surface provided now. It might be possible to recover the light volatiles (i.e. the most desirable portion because of the intended Makerol production) by means of electric precipitation with D.C. of high voltage.

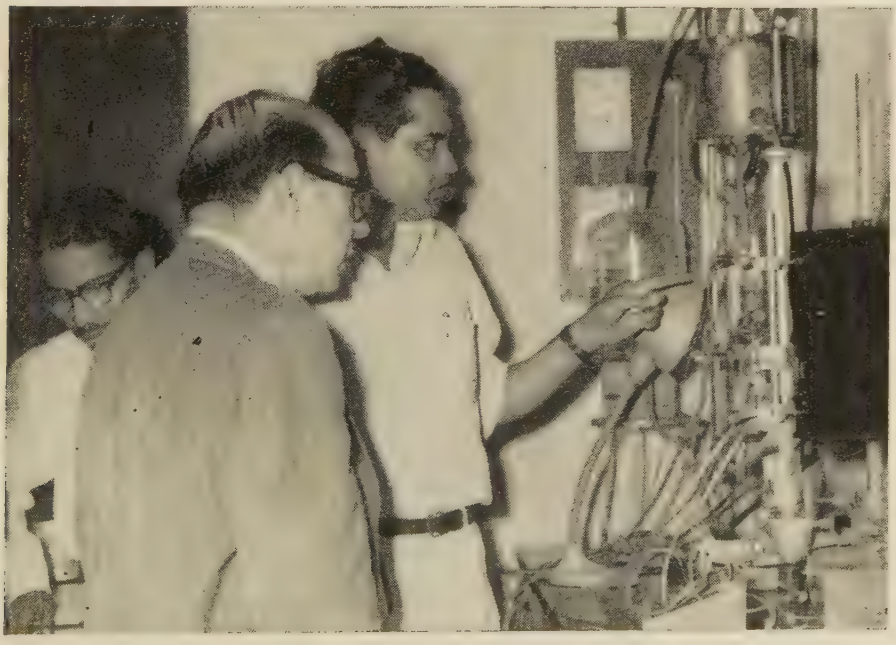
This difficulty together with the high cost of the large volume of steam required makes the fluidized system plant rather unsuitable for the present purpose. It is feasible to construct instead and inclined rotating tube—in shape like the cement producing kilns—where coal (of any size, even dust) can be fed continuously from the upper end, whereas hot gases from the combustion of Sui gas as well as steam are introduced in a counter-current direction from the lower end to process the coal in an intimate contact for a

Field Marshal Mohammad Ayub Khan, President of Pakistan, laying the Foundation Stone of the Central Laboratories. P.C.S.I.R. Mr. A. K. Khan, Minister for Industries, is on the left.

(*Above*) The Duke of Edinburgh in the Inorganic Section during his visit to the Central Laboratories. In the Centre is Dr. S. Siddiqui, Director, P.C.S.I.R.

(*Below*) Dr. James Weisner, the U.S. Expert on Salinity and Waterlogging, in the Paints and Plastics Section of the Central Laboratories.

The Duke of Edinburgh is being shown the Pharmacology Division, Central Laboratories by Dr. R. Deininger, Head of the Division.



Mr. Mumtaz Mirza, Secretary, Ministry of Finance, in the Pharmacology Division during his visit to the Central Laboratories, P.C.S.I.R.

Mr. Akhtar Husain, Minister for Education and Scientific Research, (second from left) is being shown round the Biochemical Research Division by Dr. S. Mahdihassan, Head of the Division (Others R. to L.) are Dr. S. Siddiqui, Director, and Mr. A.H. Chotani, Secretary, P.C.S.I.R.

Dr. S. Siddiqui, Director, P.C.S.I.R. (Left); Prof. M. A. Salam, Chief Scientific Advisor to the President of Pakistan (Centre); and Mr. A. H. Chotani, Secretary, P.C.S.I.R., (Right) in a happy mood during their visit to the Entomology Section of the Central Laboratories.

long period. Slightly incomplete combustion will be required, i.e. without the usual surplus of oxygen, to avoid any contamination of the coal.

Project Associates: H. von Hoessle; for workshop supplies:—Ishaq Ali, Mohammad Jehangir.

4. STUDIES IN THE THERMAL TREATMENT OF PAKISTAN COALS FOR THEIR UPGRADING:

(*a*) Carbonisation at Low Temperature (550—600°C.). As a sequel to the superheated steam treatment, of experiments on the Low Temperature Carbonisation of Makerwal Coal—others at present not being available—have been carried out using either the small 50 g. or the large 200 FISCHER—SCHRADER Aluminium Retort. Some of the experiments have been carried out with addition of steam and Sui gas, respectively. The distillation product as well as the residue were tested in respect of their analytical properties. Promising results have been obtained, and it will be more advantageous to continue these experiments on a larger scale by using the JENKNER carbonisation equipment, which has been now developed into semi-industrial plant. It permits processing, 1200 g. of coal in one instance, and among other features the complete recovery of the tarry material by means of an electric precipitator.

Project Associates: H. von Hoessle, K.V. Mustafa, Tofail Bhuiyan' Mohammad Nabiullah.

(*b*) Carbonisation at High Temperature (1000—1100°C.). To study the coking process on a laboratory scale, studies have been taken up to carbonise suitable Pakistan coals and to collect data on the feasibility of the introduction in Pakistan of the High Temperature Carbonisation Process. Until fresh coal from Khost-Sharigh, which is the most suitable for this kind of thermal treatment, is available, Makerwal coal is being subjected to the coking process to the rather complicated plant. The plant as now put up, permits (besides the complete recovery of the tarry material distilled off) the estimation of the ammonia, as well as benzene formed. Hydrogen sulphide can now be completely washed out from the rest of the gas by sodium hydroxide solution, whereby another set of washing bottles—which can be included alternatively in the system—filled with lead acetate serves as qualitative indicator for complete absorption of the H_2S in the NaOH solution. H_2S is estimated in the alkaline solution by titration with $KMnO_4$. The gas is collected in a large-size gasholder, from where it can be withdrawn for analysis.

Although the coke obtainable from Khost-Sharigh coal is not entirely

up to the standard of coke produced in Western countries, its sulfur content being too high, and the strength not sufficient to use it in the classical blast furnance, yet it may be used for the manufacture of industrial gases by gasification and the benzene, naphthalene and anthracene to be expected will be valuable basic materials for the pharmaceutical and dyestuff industry to justify the setting up of a cockery. For this reason developmental research on this problem seems to be of considerable interest. The experiments will also enable a comparative study to be made of the behaviour of the sulphur during carbonisation at various temperatures.

Project Associates: H. von Hoessle, Tofail Bhuiyan, Ehsan-ul-Haq, Zahoor Ahmed.

5. Studies in the Pyrolysis of Sui Gas: During experiments taken up towards the end of 1960, it has been observed that Sui Gas passed over an alkaline medium (most probably serving as a catalyst) in the temperature range of 1000—1200°C., undergoes a "Pyrolysis" resulting in the formation of aromatic compounds, like Benzene, Naphthalene, Anthracene etc. In the course of these studies a plant of a larger size has been constructed, which permits the collection of a lot of data for experiments on a pilot scale. The possible manufacture of these aromatic compounds from Sui gas, in absence of coking plants in Pakistan, seems to be of the greatest interest.

Project Associates: H. Von Hoessle, Azhar Habib, Ehsan-ul-Haq, Mohammad Nabiullah.

PAINTS AND PLASTICS

1. Evaluation of Storage Characteristics of Emulsion type Printing Inks: An important problem in the development and manufacture of printing inks is the control of their consistency characteristics, which are fundamental factors in determining their suitability for printing. The evaluation of rheological properties affords an excellent means of following changes of consistency on storage, and we have therefore taken up the study of these characteristics for the emulsion inks developed at the Central Laboratories. The behaviour of the inks after a short period of high speed stirring was investigated to examine the possibilities of using these tests for a quick indication of these storage characteristics, thereby obviating the necessity of prolonged tests.

The rheological measurements were carried out by using a torsion wire viscometer. It was found that high speed stirring of a sample under test gives a fair indication of changes that might take place on storage, and if an unknown sample fails to pass this high speed test, then the other tests may be dispensed with. If however, it appears quite stable after this test, then it is desirable to carry out the incubation test, because some formulations show only slight increase in viscosity after high speed stirring test, but a significant increase after the incubation test.

Publication: "Evaluation of Storage Characteristics of Emulsion Type printing inks" by Mohammad Aslam and Mohammad Sabir, Pakistan J. Sci. Ind. Research 1, 312 (1958).

2. Preparation of stable metallic soaps of rosin acids and their derivatives: Metal rosinates have a variety of uses and the desired properties vary with the application. In general, high metal content, solubility in hydrocarbon solvents and resistance to oxidation are the desirable characteristics. The present investigation deals with the preparation andproperties of stable rosinates of aluminium, cadmium, cobalt, copper, lead and zinc by (*i*) double decomposition using abietic acid, Rosin WW, Rosin FF, oxidised rosin and abietic acids, and (*ii*) fusion method, using rosin oil having different acid values. It has been found possible to prepare satisfactorily stable unmodified rosinates if the acid is not allowed to get oxidised prior to use and is taken up in the solvent as soon as precipitated in a hydrated form. The stability also depends on the nature of the metal, and the order of metals for stability is manganese, cobalt, aluminium, cad-

mium and copper. Most stable and concentrated solutions are however obtained by the fusion method, using metallic acetates and rosin oil having acid values from 0 to 80. Rosin oil of higher acid values does not give satisfactory results, and in case of aluminium, cobalt and zinc, shows blocking tendencies. This work is in the final stages of completion.

Project Associates: Mohammad Aslam and Ashhad Mehdi.

3. Process for the Production of Rosin Esters of Betulin: The acidity of rosin has to be neutralised before it can be used in varnish and other protective coating formulations, and large group of rosin derivatives such as salts and esters of rosin have thus been prepared. Of the mono- and polyhydric alcohols that have so far been employed for the esterification of rosin, methyl and ethyl alcohols, glycerol, penta-erythritol, glycol and di-and tri-ethylene glycol have been more commonly used. It has now been found that the acidity of rosin can be neutralised by esterification with betulin alone or in conjunction with other alcohols and metallic oxides. The introduction of betulin yields esters with the following improved properties, when compared with esters prepared from other commonly used alcohols: an increased softening point and increased water resistance.

Betulin was prepared from the extract of the bark of '*Betula Utilis*', known locally by the names of 'Bhoj Putr' and 'Khodang'. The extract of the bark as such has also been successfully used for the production of betulin-based rosin esters and this has made the process economically feasible. Pakistan Patent Application No. 824/60, dated 27-9-1960.

Salimuzzaman Siddiqui, Mohammad Aslam and Khursheed Alam.

4. Water Proofing Composition for Tarpaulins: The word Tarpaulin means a "Pallium" (Latin: a cloak), well tarred over to keep off the rain from any place. The custom of tarring garments or sheets for waterproofing persisted right down almost to the present century, but modern methods rely upon more scientific and rather less sticky process as for keeping out the weather, and in recent times, many non-bitumin based waterproofing compositions have been used for the purpose. Messrs. Omar Industries, Chittagong, referred their problem to the Central Laboratories to undertake investigations on their behalf with a view to (*i*) replacing paraffin wax in their formulation by some other suitable material for production of their tarpaulin and (*ii*) improving heat resistance of their product.

An improved composition consisting of a blend of metallic soaps,

modified rosin and pigments has been evolved to the satisfaction of the party concerned. The details of the formulation were handed over to the party against cash payment.

Project Associates: Mohammad Aslam and Mohammad Hussain.

5. UTILISATION OF COTTONSEED PRODUCTS FOR PAINTS, ENAMELS AND OTHER COATINGS : (*i*) USE OF MALEINISED COTTONSEED OIL FOR THE PREPARATION OF SUPERIOR QUALITY ORGANIC COATINGS : Cottonseed oil has for the first time been successfully used for the preparation of oleo-resinous varnishes according to a new process developed at the Central Laboratories and described earlier. There is however an increasing demand for superior type of organic coatings, and the use of maleinised cottonseed oil for the purpose has been investigated. The results have so far shown that co-polymerisation of rosin ester, cottonseed oil in the presence of 5-10% of maleic anhydride gives very good results. Further work is in progress.

Project Associates: Mohammad Aslam, Ali Hussain and Mohammad Hussain.

(*ii*) UTILISATION OF COTTONSEED FATTY ACID PITCH FOR THE PREPARATION OF BLACK STOVING ENAMEL: Fatty acid pitch used in this investigation was supplied by Messrs. Sadiq Vegetable Oil and Allied Industries. This pitch has been observed to gel, if heated to a temparature above 120°C. and to become insoluble in solvents. However, it dissolves in solvents at 80—90°C., leaving 5—10% insoluble matter, which has to be removed by centrifuging the solution. It has been found that the pitch, containing about 25% ester gum and 2.0% carbon black, when applied on tin panels and baked at 120°C. for two hours gives results comparable to what is obtained when the imported product is used with baking at 175°C. The results of this investigation have been sent for publication.

Project Associates: Mohammad Aslam and G. Mustafa Ali.

(*iii*) UTILISATION OF COTTONSEED PROTEINS AS A SUBSTITUTE FOR CASEIN IN THE MANUFACTURE OF PAINTS: There is a considerable demand of casein in the manufacture of dry and paste distempers, wherein it is used as a binding material, and for the manufacture of oil-bound distempers, in which its function is that of an emulsifing agent. Since casein is in short supply in the country and its price is very high, the possible utilisation of cotton-seed proteins as a substi-

tute for casein was investigated. Whereas success had already been achieved in the utilisation of cottonseed proteins for paste and oil bound distempers, its use for dry distempers was beset with difficulties. On a laboratory scale, it has now been found possible to prepare dry distempers using cottonseed proteins.

While paste and oil-bound distempers have already been produced on a pilot plant successfully, the designing of a suitable pilot plant for the manufacture of dry distemper is still in progress.

Project Associates: Mohammad Aslam and Habib Zaidi.

6. Preparation Of Carbohydrates-Based Phenolic Resins: Serveral attempts have been made in the past to co-polymerise carbohydrates with phenol and formaldehyde, but in all cases the products obtained had comparatively poor water resistance. It has recently been reported that success has been achieved in the preparation of sucrose-based phenolic resins, which compare favourably with straight phenolics. Details have not been reported. Work on these lines is also under investigation at the Central Laboratories, and sucrose has been successfully used to the extent of 25% in the preparation of modified phenolics without impairing the water resistance qualities. The ultimate aim of the project is to use molasses and starch in place of sucrose to prepare high quality phenolic resin, suitable for molding compositions, laminating resins, etc.

Project Associates: Mohammad Aslam, Ashhad Mehdi and Ali Hussain.

7. Insulating Varnish: Since the earliest days of commercial electricity, it has been necessary to treat electrical equipment with insulating varnishes, the type of such varnish to be used depending on the nature of application and the properties required. Bituminous varnishes are popular for insulating heavily worked and highly rated coils operating at elevated temperatures.

The Central Laboratories have assisted a private industrialist in developing a suitable formulation of insulating varnish, based on a certain locally available bitumin, to conform to B. S. S. bitumin specification No. 514: 1933. Varnish prepared by dissolving this bitumin in a suitable solvent gives excellant electrical insulation but fails to satisfy other requirements like drying time and aging test of the relevant specification. By the incorporation of suitable locally available materials, it has been possible to prepare a varnish which satisfies the relevant specification on all respects, e. g. (1)

the varnish dries to touch in 2 hours and becomes hard dry in 7-8 hours; at 90°C. it dries to hard film in 2-3 hours; (2)when applied on a metal panel and baked for 100 hours at 115-120°C., the varnish does not show any cracking on subjecting the panel to the bending test. The electric strength of the varnish is 2100 volts/mil for 4.0 mil thickness of varnished paper. Full details of the investigation were handed over to the party against payment of charges. (Ali Mohammad Jaffarbhoy, Shikarpur Colony, Karachi.).

Project Associates: Mohammad Aslam and A. G. Butt.

8. Starch Based Adhesives: The use of strach for adhesive purposes has been well known for several thousand years, but it is only within the last century that the starch adhesives have been developed into special forms to satisfy the various individual adhesive requirements. The physical characteristics of starch can be greatly modified to give a wide variety of adhesive products ranging from thick gelatinous pastes to quick-setting tenacious fluids. The varieties of starch most commonly used are tapioca, sweet potato, Sago, corn etc., of which tapioca is most preferred as an adhesive base, especially where transparency in the final product is desired.

Corn starch is the only starch available in the country for this type of use, and two parties referred their problems of making "Gloy" type of adhesives based on corn starch only. As a result of the investigations carried out at the Central Laboratories, it was possible to evolve two different formulas to satisfy the needs of the industries concerned.

The details of the investigations were handed over to the parties Messrs. J. K. Industries, Karachi and Messrs. Ahmad Corporation, against cash payment.

Project Associates: Mohammad Aslam and Hassan Imam.

9. Web Equipment Cleaner: This problem was referred to us by the Master General of Ordnance, General Headquarters, M. G. O. Branch, Rawalpindi. 'Blanco', which was being employed by them as a cleaner for Web Equipments used by the troops, was reported to possess several disadvantages and took a long time to dry after application. They wanted a quality comparable in performance with an imported product known as 'Renovator' which is composed of pigments, a blend of waxes and white spirit.

As a result of investigations carried out at the Central Laboratories, a suitable composition based on judicious blending of metallic soaps have

been evolved for which no wax is required. The product can be made very cheaply and has been found to be comparable in performance to 'Renovator'.

Project Associates: Mohammad Aslam and Mohammad Hussain.

10. Canal Lining Sheets: Prefabricated Canal Lining Sheet based on indigenous raw material have been produced on a pilot plant scale and sent to the Irrigation Research Institute, Lahore, where the following tests have so far been completed. (1) Water-Permeability tests under variable heads, (2) Thermal expansion and contraction, (3) Accelerated weathering tests. Actual lining experiments have been planned and a channel has been dug at the Field Research Station of the Institute at Niazbeg, near Lahore, to give field trials to this CSIR product.

Project Associates: Mohammad Aslam and Hasan Imam.

11. Manufacture of Liquid Gold: A considerable quantity of liquid gold is imported for decorative use on glass bangles and chinaware. Work has therefore been taken in hand to develop a suitable formulation which would compare favourably in performance with the imported produts. The combination of the ingredients required for getting satisfactory results has been worked out, but the main difficulty of stabilising the composition in a liquid form is still only partly solved. Terpenes-sulphur reaction products have been used to prepare complex compounds with metallic chlorides. Auric chloride forms a perfectly stable complex, but the chlorides of other metals which have to be incorporated into the composition are not so stable. Attempts are being made to stabilise these compounds or to prepare new stable complexes, which could be used in the final formulation of liquid gold.

Project Associates: Mohammad Aslam, Karimullah, Riaz Ali Shah and Ashhad Mehdi.

12. (*a*) Utilization of Waste Sulphite Liquor for Extraction of Tannins: Many uses for waste sulphite liquor are known but the process of concentrating the liquor makes most of them uneconomical. Its use as an auxiliary material for vegetable tanning is known, and it was therefore considered advisable to try the dilute waste liquor as such for extracting the tannins and utilising the extracts thus prepared for tanning purposes. Preliminary work has given encouraging results, and this approach appears likely to make the use of sulphite waste liquor economically feasible. Further work is in progress.

Project Associates: M. Jamil Khan, Shafiur Rahman and Faiz Ahmad.

12. (*b*) UTILIZATION OF BABUL BARK FOR TANNING: Babul bark is being used by the tanning industry in conjunction with wattle and myrobalam extracts. Since this bark is available in quantities, it was felt necessary to undertake systematic investigation on the utilisation of this bark with a view to assessing the maximum percentage of babul bark tannins that can be used in conjunction with other tannins without impairing the quality of leather. The percentage of tannins found in the bark of different age groups has been determined, and further work is in progress.

Project Associates: M. Jamil Khan, Shafiur Rahman, and Ajmal Khan.

V

EAST REGIONAL LABORATORIES

EAST REGIONAL LABORATORIES

MEDICINAL PLANTS

1. CONSTITUENTS OF *Andrographis Paniculata*: The leaves of the plant were extracted with petroleum ether and then with rectified spirit. The first extract yielded a mixture of waxes from which two distinct solid products have been isolated of which one is a wax (m.p. 83—84°) and the other appears to be of low mp. approximately 35°. The spiritextract gave a number of products, of which one has been reported earlier in the literature as andrographolide (m.p. 230°C.), Another constituent melting at 193—198°C. this latter on further crystallisation gave two products one melting at 138—40° and the other at 276°C. with decomposition.

The andrographolide, melting at 230—31°C., absorbed bromine and gave a dibromide m.p. 97°C. quite readily. But the dibromide slowly takes up more bromine indicating thereby another unsaturated centre with inhibited additive tendency. The same substance can be hydrolysed easily into a mixture of acids, of which one melting at 183°C., slowly changes into the original compound; showing thereby that it is a lactone which changes into an acid with cis configuration, which reforms the original lactone; while the other acid m.p. 156°C., seems to be more stable and therefore has perhaps a trans configuration. The original acid is an unsaturated lactone having hydrogenated naphthalene ring and therefore the appearance of the stereoisomerism of the acids here can perhps be readily explained. More work is in progress to decide about the constitution of andrographolide as well as of the other constituents m.p. 138—40°C. and 276°C.

When most of andrographolide crystallises out, the alcoholic mother liquor becomes thick and deeply coloured; and on being diluted with water precipitates a brownish amorphous solid, which on repeated extraction with benzene gave a colourless crystalline solid melting at 175°. This too is very bitter, and has been named by us as Panicolide. The brown residue on being chromatographed gave still another solid crystalline material melting at 113°C., which is not bitter to taste.

Panicollide has on examination been found to be an $\alpha\beta$ unsaturated lactone, containing two hydroxyl groups, one of which is secondary in character and the other tertiary. Diacetate, dibenzoate, phenylurethane and cathylate, have been prepared. Infrared studies suggest it to be a Υ-lactone. The secondary hydroxyl group seems to be equatorial. Panicolide on oxi-

dation gives a monoketonic compound which gives a D.N.P. melting at 199-201°C. and its I.R. bears evidence of the existence of both a ketonic and hydroxyl group. Seleniumdehydrogenation yields a naphthalene derivative. The determination of the constitution of the compound is nearing completion.

The non-bitter constituent m.p. 113° appears to be widely different from the others, and infrared absorption records give an indication of its being a carbonyl compound. Further work on these is in progress.

Project Associates: M. Qudrat-i-Khuda, M.A. Ali and K.M. Biswas.

2. *Hygrophila spinosa:* This plant, locally called *Talmakhana* is common in moist places everywhere throughout Pakistan and India. The whole plant, its root and seed are used medicinally. The seeds are demulcent, diuretic and possibly tonic, and are therefore used in the treatment of diseases of genito-urinary tract.

The seeds were extracted with alcohol and the extract, on removal of solvent, yielded viscous oil which was again extracted with petrol ether. The petrol ether insoluble portion was a water-soluble syrup which, after hydrolysis, was found to contain rhamnose and fructose (paper chromatography). The petrol ether extract yielded an oil (15% of the wt. of seed). The chemical constants of the oil were determined and, after saponification, the fatty acids were isolated. The saturated acids were separated from the unsaturated acids by the lead salt method. The individual separation of the saturated fatty acids (7% of the total acid) were achieved by fractional distillation of their methyl esters.

From the unsaponifiable portion of the oil (1.5% of the oil), two well-crystalline sterols have been obtained. Acetates of these sterols have been prepared. Infrared spectrum is like that of a typical monohydroxy sterol, and it is hoped to characterise these sterols very soon.

The seeds of Talmakhana were extracted with water and the water-soluable mucilage, after hydrolysis, was found to contain xylose and two other sugars (paper chromatography). Further work is in progress.

Project Associates: M. Qudrat-i-Khuda, M. A. Ali and Jagadish Chakravarti.

3. *Caesalpinia bonducella* : This medicinal plant of East Pakistan is used extensively by Ayurvedic Physicians for the treatment of various diseases. The entire plant—the seeds, the leaves, the stem, the root-is bitter and is used medicinally.

(*a*) *Bitter Principles of the Seeds:* Attempts had been made in India in the past to study the bitter principles of the seeds but no crystalline bitter product was obtained from the seeds. As a result of our systematic investigation we have, however, been able to isolate for the first time three distinctly crystalline bitter principles, named by us as ∝-Caesalpin, white rectangular plates, m.p. 187°, β-Caesalpin, colourless hexagonal plates, m.p. 243° and ϒ-Caesalpin, m.p. 104-120°. The last named compound is however, amorphous, and on hydrolysis, it gives a crystalline bitter substance in colourless hexagonal bars, m.p. 252° which we have termed hydrolysed ϒ-Caesalpin.

∝-Caesalpin (0.01%), $[\alpha]_D^{23°C} = 37°$, has a molecular formula $C_{22}H_{32}O_8$ and is not a glycoside nor a carboxylic or lactonic compound. It contains two O-acetyl groups and one carbonyl group. The carbonly group is not unhindered since a DNP. was obtained only on boiling with the reagent. The bitter also contains a furan ring. Alkaline hydrolysis of ∝-caesalpin brings about hydrolysis of one acetoxyl group and elimination of the other giving β-caesalpin. β-Caesalpin is therefore, probably formed in the seeds from ∝-caesalpin by some kind of combined effect of hydrolysis and elimination through enzymic action.

β-Caesalpin (0.03%), $[\alpha]_D^{23°C} = +68—75°$, has a molecular formula $C_{18}H_{26}O_5$ and contains one hydroxyl group besides a furan ring and hindered carbonyl group. Its crystalline mono-acetate melts at 218° and its DNP, orange red needles, melts at 278°.

Hydrolysed ϒ—caesalpin (2.6%), $[\alpha]_D^{30°C} = +40°$, has a molecular formula $C_{20}H_{30}O_5$. It is not a glycoside and contains two hydroxyl groups, one furan ring and hindered carbonyl group. Its DNP, orange needles melts at 264°. Further work on the constitution of these bitter principles is in progress.

Publication: "Bitter Constituents from *Caesalpinia bonducella.* Flem." by M. Erfan Ali and M. Qudrat-i-Khuda, Chem. and Ind. (London), 1960, 463.

(*b*) *Other Constituents of the Seeds of Caesalpinia bonducella:* Other constituents besides seeds ∝, β and ϒ caesalpin are (1) β—sitosterol, (2) an oil, (3) some sugars and (4) protein.

The oil (ca. 20%) was found to have an Iodine Value 132 and saponification equivalent 200, and on standing it gradually deposits a jelly-like substance. An examination of this oil has shown that it contains unsaponifiable matter (ca. 1%) which is a crystalline compound, m.p. 136-37° giving a

crystalline acetate, m.p. 122°. This unsaponifiable matter also responds positively to the Leibermann-Burchard test for sterol. It is presumably β—sitosterol. The fatty acid constituents of this oil are linoleic acid 51%, oleic acid 22% and saturated acid mixture 13%. No linolenic acid could be detected. The saturated fatty acid mixture melted at 52°C. which on repated crystallisation from 90% ethanol gave a product, m.p. 64°. This is presumably a mixture of palmitic and stearic acids.

The sugar constituents of these seeds were isolated in about 7% yield in the crude form. From this crude mixture sucrose has been isolated in two crystalline forms—one in the form of cubes and the other in rectangular bars. The residue left after removal of sucrose was found to be reducing and composed of 11% reducing sugar and 46% sucrose. The seeds contain a high % of water soluble protein which is ca. 27%.

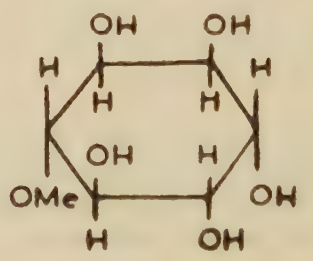
Further work on all these constituents is in progress.

Publication: Investigations on ***Caesalpinia bonducella.*** Part I. A Preliminary Note on this Constituent, by M.Qudrat-i-Khuda, M. Erfan Ali and M. Sidiqueullah, Pakistan J. Sci. Ind. Research, 1960

(c) *Constituents of the leaves of Caesalpinia bonducella:* There is no report in the literature of any investigation on the leaves. Our studies have afforded several interesting constituents, namely (i) an amorphous bitter substance (0.35%), (ii) a crystalline sweet product (about 5%), (iii) a waxy material and, (iv) a viscous reducing product.

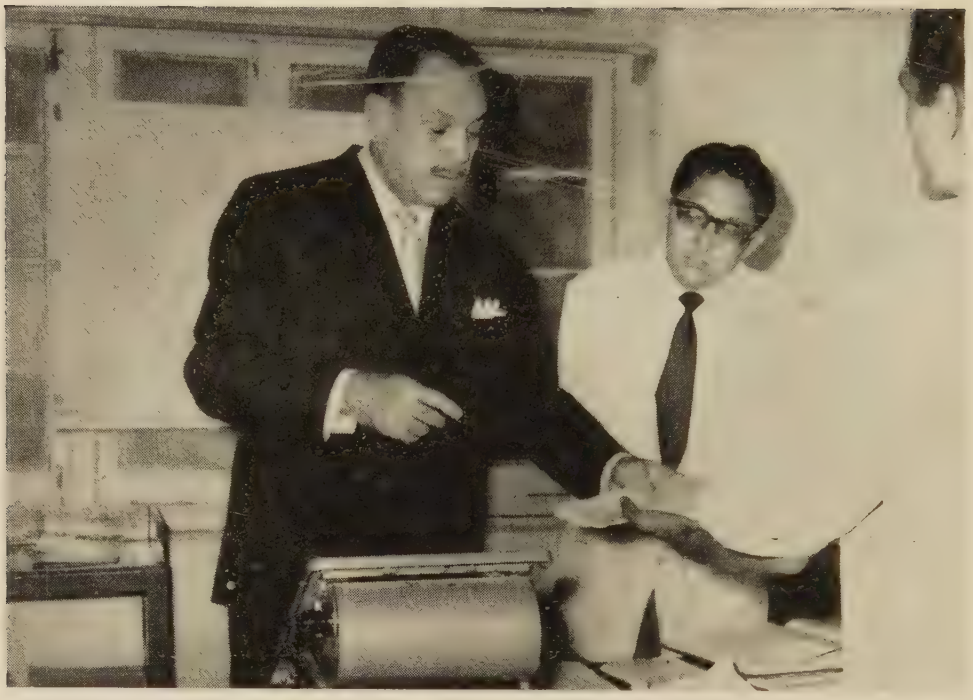
The amorphous bitter substance, m. p. 158-60° $[\alpha]_D^{30°C} = +16.5°$, has a molecular formula $C_{27}H_{40}O_{13}$. Further work on this bitter is in progress.

The sweet crystalline product, m.p. 187° is not sucrose since its mixed melting point with sucrose was much depressed. It has molecular formula $C_7H_{14}O_6$ and $[\alpha]_D^{34°C} = +66°$. It has one methoxyl group. It could be acetylated but no crystalline compound was obtained. It gave a crys-



(*Above*) **Dr. James Weisner is being shown round the Workshop of the Chemical Engineering Division, Central Laboratories by Dr. S. Siddiqui, Director, P.C.S.I.R.**

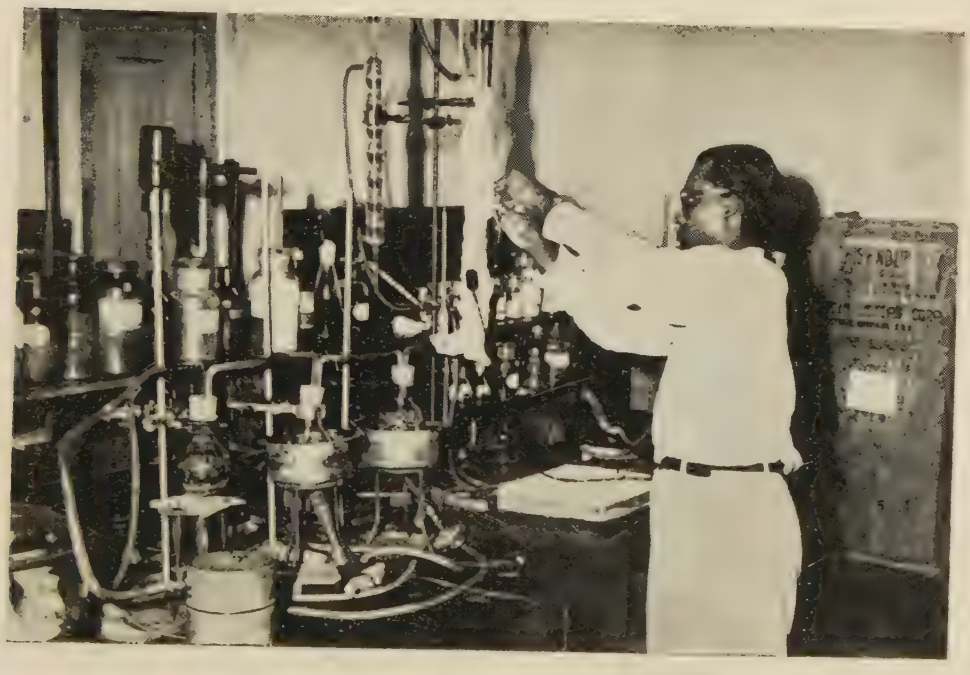
(*Below*) **Mr. Mumtaz Mirza, Secretary, Ministry of Finance, in the Physical Research Division during his visit to the Central Laboratories.**



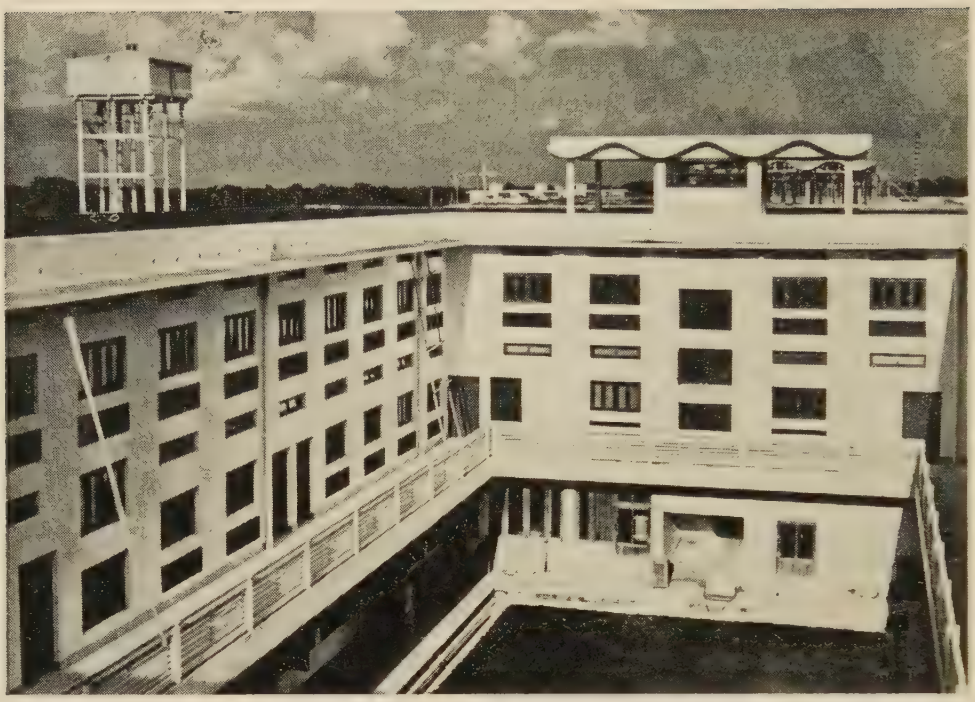
The President of Pakistan is being shown round the Photographic Section of PANSDOC by Mr. A.H. Chotani, Secretary, P.C.S.I.R. who is on his left.

The Food Technology Building, East Regional Laboratories.

A view of the Workshop of East Regional Laboratories (under construction), Water Tower, and Staff Quarters.



A view of the Fibre Laboratory, East Regional Laboratories.



(*Above*) **Inside view of the Food Technology Building, East Regional Laboratories.**

(*Below*) **Aview of the Ceramics Laboratory, East Regional Laboratories.**

talline di-isopropylidene derivative, m.p. 104° and $[\alpha]_D^{31°C} = -30.5^{c}$. All these properties correspond to those of pinitol which is a monomethyl ether of *d.* inositol and we call this product Caesalpinitol to indicate its source. Further work on this and other constituents of these is underway.

Project Associates: Q. A. Ahmed, M. Erfan Ali and M. Qudrat-i-Khuda.

(4) ALKALOIDS OF *Datura fastuosa* AND *Datura strammonium:* Although the presence of the mydriatic alkaloids, atropine and hyoscyamine in *Datura strammonium* AND *Datura fastuosa* have been reported since the 19th century there has been no thorough investigation about the possibility of industrial utilization of these plants widely available in Pakistan. This was undertaken in this laboratory as early as 1956, and crude alkaloidal mixtures were isolated in appreciable yields (0.3% in leaves and 0.25% in stem-bark).

The project was again taken up in 1960, and alkaloid mixtures have been obtained in better yields from *Datura strammonium* seeds (0.37%) and leaves (0.32%). The crude alkaloid mixture (foam) was subjected to alumina chromatography with benzene as the starting eluant. The fraction, that was eluted with ether gives after three crystallisations (colourless needles) from benzene-petroleum either a substance melting at 103°C. (of atropine, m.p. 118°C.). The infrared spectrum (in nujol) of this alkaloid is only slightly different from that of atropine (E. Merck) and it is most probably hyoscyamine.

The benzene eluant fraction of the above chromatography, however, did not crystallise from any solvents. The hydrochloride of these fractions was made by passing dry hydrochloric acid gas through its ether solution and the infrared spectrum (nujol) was determined after 3 crystallisations (m. p. 188°C.) from acetone. After liberating the free base (glass), infrared spectrum was determined (thin film). From the melting point of the hydrochloride as well as the infrared spectra of the free base and hydrochloride, this compound (alkaloid B) appears to be different from atropine or hyoscyamine. It has a strong hydroxyl absorption at 3400 cm-1 whereas the hydroxyl peak in the infrared spectrum of atropine or hyoscyamine is not sharp. Further works on this alkaloid and the feasibility of the industrial utilization of the Datura alkaloids are in progress.

Project Associates: M. Qudrat-i-Khuda and Abdul Khaleque.

OTHER NATURAL PRODUCTS

1. Composition of Jute Stick and its Utilization: East Pakistan grows about 60 lakh bales of jute annually. Two to three times its weight is lost as jute stick, which is at present almost entirely burnt as fuel. It is therefore worthwhile to find an alternative and more economic use for it and hence a programme of research on it was taken up.

Through the courtesy of the Jute Research Institute of Pakistan and the Central Jute Committee, samples of jute stick were procured. Preliminary analysis indicates that practically pure furfural to the extent of 11-12 per cent may be obtained from it. Accordingly methods are now being standardized for producing this chemical in quantities, as it can yield important products such as plastics and insecticides. Moreover, treatment of the jute stick powder with alkaline nitrobenzene appears to yield very valuable cellulose. Economics of the reaction as well as the properties and uses of this cellulose are now under investigation.

Project Associates: M. Siddiqueullah and M. Qudrat-i-Khuda.

2. Spinnable Fibre from Jute Cuttings: A huge quantity of jute cuttings accumulate and remain lying around without disposal. The cutting had a mass of stiff barky material attached which prevented the fibre from being separated easily and un-injured from these scales. It was considered very necessary to find out a quick method for producing spinnable fibre from jute cutting. The work was undertaken and completed on a high priority basis and ultimately the fibre was obtained in a soft spinnable form. A patent on the process has already been taken out.

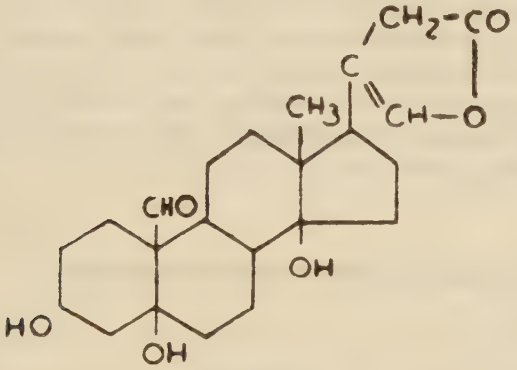
Project Associates: Salimuzzaman Siddiqui, M. Qudrat-i-Khuda and M. Manzoor-i-Khuda.

3. Modification of Jute Fibre: The fibre from matured jute plants is not quite the strongest, and consequently it does not fetch adequate return to the grower. Such fibres have been treated in these laboratories to see if their properties can be improved. From the ordinary fibres, a white glossy mass has been obtained which is capable of taking dyes. Further treatment of the delignified fibre with suitable solvents to render it strong, glossy and soft, as well as make it a continuous yarn, is now in hand. The results already obtained are quite encouraging but more work is needed

before a final conclusion about the possibilities of the modified fibre can be drawn.

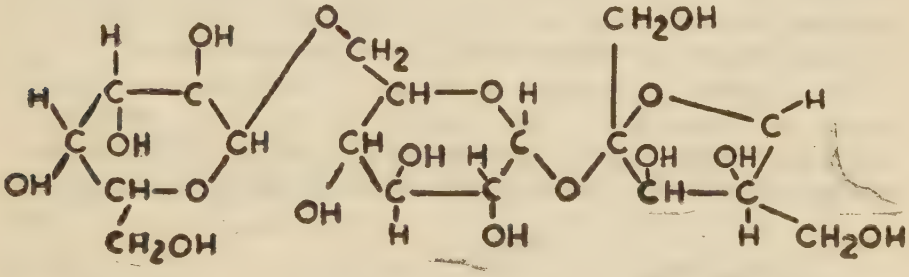
Project Associates: M. Qudrat-i-Khuda and A. K. Chakravarti.

4. CONSTITUENTS OF JUTE SEEDS: Investigations have been undertaken on the seeds to see if it can yield commercially useful materials. Through a series of experiments on the jute seeds, it has been possible to isolate a very strong cardiac stimulant, which is at present prepared from STROPHANTHUS KOMBE and sells at Rs. 30/- per gram. Experiments show that it can be obtained from jute seeds to the extent of 0.5% of the weight of the seeds. It has been estimated on this basis that one maund of jute seeds will yield nearly Rs. 5,500/- worth of strophanthidin alone.



STROPHANTHIDIN (J. Biol. Chem. 54, (1922) or 88, 519 (1930)

Further, the jute seeds yielded about 4% by weight of a rare sugar called raffinose, which is at present recovered from beet molasses and marketed



at Rs. 32/- per ounce and, therefore, Raffinose valued at Rs. 1200/- may be obtained from each maund of the seed. In addition, a maund of the seeds will yield some $6\frac{1}{2}$ seers of a semi-drying oil, which has been named Jutoil. This promises to be as useful as cottonseed oil in industrial application.

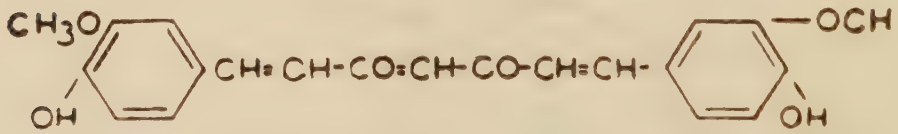
A patent for the process, and apparatus for the production of strophanthidin, raffinose and Jutoil has already been filed.

Project Associates: M. Qudrat-i-Khuda, A. Khalique (Sr.) and D. C. Das.

5. Jute Leaf: The dried leaves of the jute plant have long been used medicinally in East Pakistan, but no active principle had previously been obtained from it. The present work has led to the isolation of two different crystalline bitter substances possessing saponin- like properties. Of these the Bitter 'I' has a m. p. 170° $[\alpha]_D^{30} = -22.6°$, and shows a hydroxyl absorption at 1.70μ in I. R. The Bitter 'II', m. p. 268-269°, $[\alpha]_D^{22} = +38.9°$, shows characteristic absorption maxima at 212μ and also shows a hydroxyl absorption at 2.82μ. Further work is in progress.

Project Associates: M. Qudrat-i-Khuda, A. Khalique (Sr.) and D. C. Das.

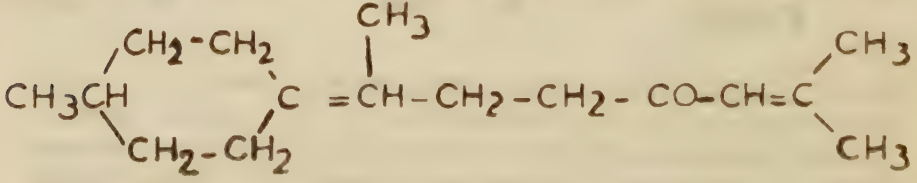
6. Curcumin and Curcumone from Turmeric: *Curcuma longa* is being produced in quantities in excess of its consumption for domestic use of Pakistan. The problem of possible industrial utilization of the excess of this agricultural product was referred to us recently. On examination, it has been possible to evolve a simple and efficient method for the preparation of the dye curcumin, m. p. 171°C.,



CURCUMIN

Our method ensures about 3% yield of the dye, which is a very expensive chemical at present. By careful work it can be expected to give an income of about Rs. 6000/- per maund of turmeric. The compound exhibits an important isomeric change, another compound melting at 144-148°C. being obtained, and this new phenomenon is under study at present.

In addition, an essential oil can also be obtained from turmeri: along with some starch. The essential oil has a b.p. 84-90°/33-34 $[\alpha]_D^{30} = -25.50°$; $[n]_D^{22} = 1.50530$ and $[\alpha]_4^{31} = 0.928227$. The I-R study reveals the fact that the essential oil has double bonds, a ketonic group, is



CURCUMONE

most probably curcumone. Further work in elucidation of its constitution is still in progress.

Project Associates: M. Qudrat-i-Khuda, A. Khalique (Sr.) and Mrs. S. Nahar.

7. SYNTHESIS OF CALAMONIC ACID: In an earlier investigation on Calamol the essential oil from *Acorus calamus*, it was recorded that on oxidation it gave an acid, which was called calamonic acid and was considered to be a trimethoxy benzoic acid melting at 143°C. The position of the three methoxyl groups was however, left undecided.

It has been found in these laboratories that locally availabe *Acorus calamus* gave similar quantities of Calamol as has been recorded by earlier workers. This calamol was oxidised and the acid obtained was compared with the one synthesised in these laboratories according to the following plan. Ortho toluidine was taken as the starting material for the synthesis, which ultimately gave 2:4:5: trimethoxy benzoic acid. Asaronic acid has been given the same configuration. It appears that this synthetic acid is identical with calamonic acid.

This synthesis suggests that calamol is 2:4:5: trimethoxy allyl benzene.

Project Associates: M. Qudrat-i-Khuda, M.A. Ali and S.A. Rahman.

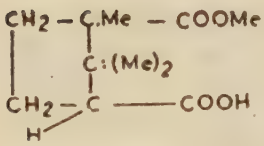
8. COCONUT PRODUCTS: The important constituents of the coconuts of East Pakistan have been separated. Fine coir of different colour and fineness have been prepared, which promise to be of use for diffetent purposes. The oil extracted by wet process, showed a recovery of 99 per cent, and the quality has been found to be of a very high order. The residual pulp is being separated into the protein and carbohydrate fractions which may be suitable for human consumption. This has been described under "Food Products".

The hard inner shell has been put to destructive distillation and the results have been given under "Fuel Research". Further work is going on with the husk separated from the outer shell after the removal of coir.

Publication: by M. Qudrat-i-Khuda and M. Rahmatulla, Pakistan J. Sci. Ind. Research, (1959) Vol. 2, No. 3, page 259.

9. EXAMINATION OF THE CONSTITUTION OF THE ACID ESTERS OF CAMPHORIC ACID: Further confirmation has been obtained about the stercoisomeric relationship of acid esters of camphoric acid.

Methyl hydrogen esters of *dl*-camphoric acid were prepared and the *allo* and *ortho* esters were found to behave as stereo-isomers I and II and not as position isomers III and IV.



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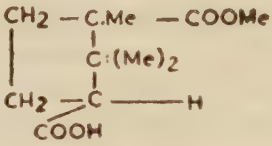

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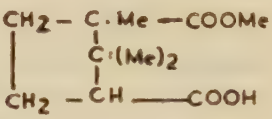

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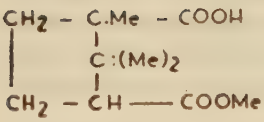

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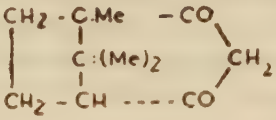

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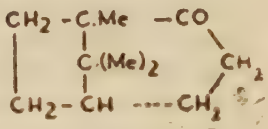

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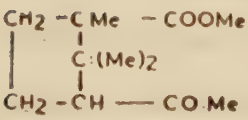


V

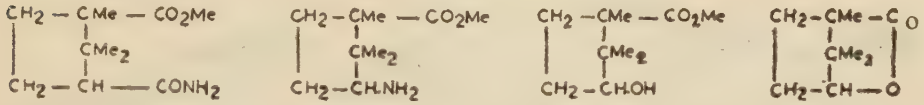
The conversion of the so-called *ortho* ester into the *allo* one could not have taken place if the isomerism was due to position as in III and IV.

The acid chlorides of the acid-esters gave one and the same ketone V when reacted with zinc methyl iodide. This ketone underwent Deckman Codensation to give 1:1:5:-trimethyl-2:5-*bicyclo* hexane-6:8-dione (VI). On clemmenson reduction it gave a mixture of three products one of which is 1:1:5-trimethyl-6-keto *bicyclo* hexane (VII).

Project Associates: M. Qudrat-i-Khuda and M. Manzoor-i-Khuda.

10. Isomerism of Camphoramic Acids: The amic acids of dextro camphoric acid have been prepared along with the amic esters by relevant methods.

These have been degraded into the corresponding amino compounds which have been converted into the lactone as follows.



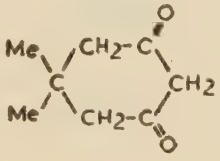
Project Associates: M. Qudrat-i-Khuda and A. Sattar.

11. EXAMINATION OF THE SEEDS OF BLACK JAMAN: The seeds of *Eugenia jambolina* are known to be used in the treatment of diabeties, and the active principles of the seeds are therefore being looked for. The dried powdered seeds were extracted with rectified spirits and the extract has been separated into an oil (7%) and other products (9%). The oil has $\alpha_{40}^{26} = .90045$, n_0 25°C = 1.47150, Iodine Value 74, Saponification Value 71 and Acid Value 19. The rest of the material is still being examined.

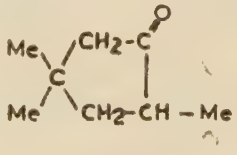
Project Associates: M. Qudrat-i-Khuda and A. Sattar.

12. STUDIES IN RING TRANSFORMATION. PART I: CLEMMENSON REDUCTION CYCLOHEXANE β-DIONES.

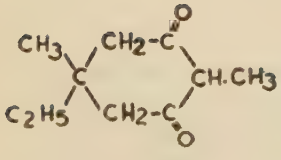
Various cases of contraction of alicyclic rings are known but one of us (M. Q. K) observed a new type of ring transformation in course of clemmenson reduction of dimethyl dihydroresorcinol (I) where it was found hat cyclohexane ring under went a transformation into a lower ring and gave trimethyl cyclopentanone (II).



(I)



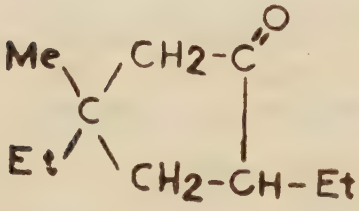
(II)



(III)

With the expectation that is a general reaction some more dihydroresorcinols have been examined. 1:4-dimethyl-1-ethyl-3:5-dione (III) was prepared and this on Clemmenson reduction has given three products isolated

as their semicarbazones. This included the expected five membered ketone (V) together with a six-membered ketone (VI).



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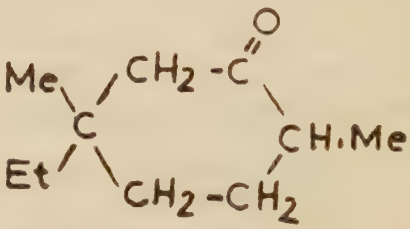


VI

Project Associates: M. Qudrat-i-Khuda and M. Manzoor-i-Khuda.

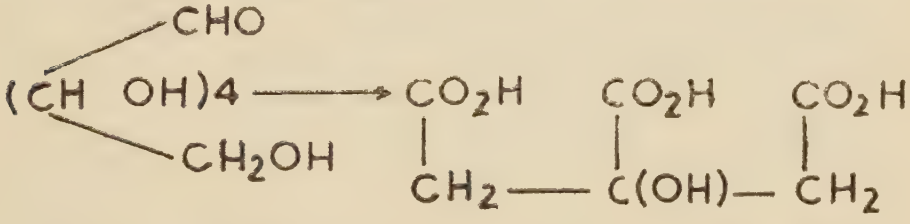
INDUSTRIAL WASTES

1. Recovery of Sucrose from Molasses: The problem of utilisation of molasses, which are being produced in excess of local comsumption was referred to us by Government, and a comprehensive investigation has been undertaken. The total annual production of molasses in the region will come to about 10 lakh maunds. An examination of the molasses suggested that it still contains about 30 per cent of cane sugar or sucrose, along with invert sugar, mineral substance, proteins and moisture.

For recovery of the cane sugar, a prosess has been evolved wherein a barium double compound is separated and then sucrose recovered in its entirety. The process is now undergoing pilot-plant tests and patent is being filed.

Project Associates: M. Qudrat-i-Khuda, M. Erfan Ali and A. K. M. Khan Khadem.

2. Citric acid from Molasses: Along side of the process for the recovery of cane sugar from molasses, it is found that the molasses can be put to fermentation to produce new compounds besides those that are being produced within the country. Of the several possibilities examined a method of production of citric acid from it has been worked out with encouraging results.



GLUCOSE CITRIC ACID

Eight citric acid producing micro-organisms have been isolated from different sources, such as soil, bread and lemon. Out of these, at present we are working with only two organisms; one is marked as no. 21 and the other as no. 12, and so far, we have used two samples of molasses. One of them contained 49.5% of sugar in terms of reducing sugar out of which 34% is non-reducing. In the other sample, the toal content of sugar in terms of reducing sugar is 49.8% out of which 29.8% is non-reducing. The ash content of molasses is 7.8%. The nitrogen content in the first case is 0.77% and in the second case 0.2%.

With organism No. 21, fermentation experiments were carried out both in surface and submerged culture methods. This organism is not capable of producing cirtic acid in terms of anhydrous acid in 7 to 8 days in surface culture process. The optimum temperature of the fermentation is 30-31°C. The work is still in progress.

The organism No. 12 also produces citric acid of about 35% by surface culture method in 6-8 days. The submerged culture has not yet been tried. The optimum temperature is again 30-31°C. This work is also in progress.

Project Associates: M. Qudrat-i-Khuda, N. M. Sheikh, G. K. Joarder and S. A. Ahmed.

3. Yeast, Acetone and Butanol from Molasses: As an extension of the fermentation process developed for production of citric acid from molasses, which has been described above, the possibilities of obtaining some other products are also being studied. Strains of micro-organisms have been developed and are being separated for large scale production of yeast, acetone and butanol. The efforts started in late 1960, have shown very encouraging results and it may be possible to report definite success in these direction within a year or so.

Project Associates: M. Qudrat-i-Khuda, N. M. Sheikh.

FUEL RESEARCH

1. Destructive Distillation of East Pakistan Fire Wood and Coconut Hard Shell: Large quantities of different kinds of fire wood is wastefully burnt throughout East Pakistan. While it is desirable that some alternative fuel should be available to the people so that timber resources can be put to a more economic use, so long as an alternative fuel is not available, the entire quantity of available fire-wood should be put to destructive distillation and the charcoal thus obtained supplied to the people as more concentrated domestic fuel, the large quantity of distillate being available for development of several chemical industries. With this end in view, several types of fire wood have been subjected destructive distillation and the results have been given in the accompanying table.

Similarly, when coconut oil industry functions in East Pakistan, large quantities of coconut shell will also be available as by-products and typical samples of these have been distilled with the results shown in the last row of the table.

Table showing results of destructive distillation of various types of woods.

Name Of Wood	Quantity distilled in lbs.	Volume of Distillate collected in c. c.	Tar obtained in c. c.	Acetic Acid separated in c. c.	Wood spirit collected in c. c.	Charcoal Residue	Gas Produced in litres
Goran Heart Wood.	12.75	2567	370	202	70	4th 703	833
Bazna	12.75	2735	520	170	60	4th 1203	1033.85
Sundri.	21	3755	735	251	132	5th 803	1409.48
Gazari	18	3545	515	X	65	5th 1403	872
Coconut Shell	18	4118	851	392	85	4th 7503	911

Coconut shell phenolic body gave 33% of Carbolic acid, 16% of Cresol, 20.7% Guaiacol and some 6% of ∝-naphthol and resorcinol mixture.

Project Associates: M. Qudrat-i-Khuda and M. Rahmatulla.

2. DISTILLATION OF PEAT: Peat is an important natural product of East Pakistan with a large availability, and therefore merits special attention for examination of its value as a substitute for coal. A systematic study has been undertaken and samples of peat have been subjected to (i) low temperature carbonisation, (ii) superheated steam treatment and (iii) solvent extraction.

The distillate collected during low temperature carbonisation consists of a variety of compounds. The more important of these are some unsaturated hydrocarbons, phenolic bodies as well as pyrindino and Quinolin bases. The gaseous product gave some quantity of ammonium sulphate on scrubbing with sulphuric acid and a sulphur-containing fraction, out of which sulphur could be precipitated. The observations are quite interesting, but more work is needed before any conclusion can be drawn regarding their industrial utilization.

Project Associates: M. Qudrat-i-Khuda and M. A. Saboor.

CERAMICS, CLAYS AND MINERALS

1. Ceramics from Bijaipur Clay: The only white clay so far available in East Pakistan occurs in the Bijaipur area of the District of Mymensingh, East Pakistan, in a fairly large quantity for industrial exploitation. Our budding ceramic industries will chiefly depend on this raw material. This clay is composed of Silica 72.60%, Alumina 19.10%, Ferric Oxide 1.40%, Calcium Oxide 0.16% and Alkali oxides 0.48%, with an ignition loss of 5.80%.

It contains a considerable quantity of free silica and iron oxide as the objectionable impurities and in consequence, it has been found suitable for making ordinary pottery but unsuitable for good whitewares and procelains. On beneficiation by washing and elutriation, the clay has yielded a product almost free from iron oxide and from the bigger particles of silica. This beneficiated clay analysis as Silica 59.76%, Alumina 29.44%, Ferric oxide 0.34%, calcium oxide (trace), sodium oxide 0.16%, potassium oxide 0.15% and a loss on ignition 9.88%. Although, it contains a small quantity of residual fine particles of silica, this beneficiated clay can be considered as a pure one for all practical purposes. The method of beneficiation, although so far developed on a laboratory scale, furnishes adequate evidences for its economic application to industries. The pure Bijaipur clay will, therefore, offer a great future in the manufacture of good porcelains, whitewares, electrical insulators and refractories, etc.

Examination of various physical properties of this clay is in progress, and evidence already available from our studies tends to prove that the clay is composed of a clay mineral of the kaolinite type.

Project Associates: A. K. Basak, M. A. Biswas and M. Qudrat-i-Khuda.

2. Mirpur Clays: Four types of clay, (i) Red, (ii) Black, (iii) Grey and (iv) Cream, occur abundantly in the Mirpur area of the District of Dacca, East Pakistan, and are used in the manufacture of bricks, tiles, clay pipes and earthenwares etc. Samples of these clays have been carefully analysed in our laboratory and the red and black varieties have been beneficiated.

The beneficiated red clay is composed of silica 54.96%, alumina 23.03%, ferric oxide 9.57%, calcium oxide (trace), alkali oxides 0.38% and of a loss on ignition 10.21%. The beneficiated black clay is composed

of silica 48.49%, alumina 23.25%, ferric oxide 2.10%, calcium oxide (trace), alkali oxides 0.30%, with a loss on ignition 21.50%. The red colour of the red clay is due to the iron, most of which is present as hydroxide and is easily removable by a dilute acid treatment. Various properties of this clay are under examination and the evidence available indicates that the clay is composed of kaolinite mineral. The black clay shows a high ignition loss, which is due to the presence of organic matters, mostly of resinous type. It has a high plasticity and can be used conveniently in combination with other less plastic clays for ceramic manufacture. Its physico-chemical properties are under examination.

The grey clay closely compares with the red clay, although, its iron content is appreciably lower than that of the red one, and further investigations into the physico-chemical properties of the grey and cream clays are in hand.

Project Associates: Mrs. S. N. Nabi, M. A. Biswas and M. Qudrat-i-Khuda.

3. (i) Base-exchange Property of Clays: Base-exchange property of a clay determines various important physical characteristics e.g. plasticity, shrinkage viscosity of clay slips, drying property, particularly when the clay is in water medium. Base-exchange capacities of Bijaipur clay and Mirpur clay (red) have been determined by (i) ammonium acetate leaching, (ii) ion-exchange resin method and (iii) transformation of the clay into the hydrogen form with dilute hydrochloric acid and determination of the acid liberated with a solution of potassium chloride or sodium chloride. Well-elutriated clay samples were used for these determinations. The low base-exchange capacities of Bijaipur clay (4.13 m.e./100g) and that of Mirpur red clay (10.5 m.e./100g) suggest that both of these clays are composed of kaolinite clay mineral. Studies of the base-exchange property of other clays are under progress.

Project Associates: A. K. Basak, M.A. Biswas and M. Qudrat-i-Khuda.

3. (ii) Alumina from Bijaipur Clay: Beneficiated Bijaipur clay contains about 30% alumina and 0.34% of ferric oxide. Since East Pakistan does not have good bauxite ore, the Bijaipur clay or other clays may be the possible alternative sources of alumina. A thorough study of the leaching effect of sulphuric acid on Bijaipur clay (calcined and uncalcined) has been undertaken. The experiments so far done with uncalcined clay have shown that the maximum extraction of alumina is about 45%, together with the

whole of iron. This requires that the clay is leached with 10 normal sulphuric acid for about six hours at a temperature of 200°C.

Project Associates: M. A. Rouf, M. A. Biswas and M. Qudrat-i-Khuda.

4. (i) PROPERTIES OF CERAMIC ARTICLES MADE FROM BIJAIPUR AND MIRPUR CLAYS: The working properties of beneficiated Bijaipur clay are found to be satisfactory. Articles made from it show linear shrinkage of about 8% at 1200°C. and about 5% at 1000°C. The colour of the articles fired at 1000°C. is white with a touch of pink and that of the articles fired at 1200°C. is white with a touch of yellow. Both these colours are satisfactory for the manufacture of whitewares and porcelains. Some electrical insulators, such as heater-bases, fuse-holders, etc., have been prepared and their insulating properties have been found to be satisfactory for our purposes. Although, the refractoriness of this clay could not by studied fully, the clay has been satisfactory for producing refractory products like fire clay tringles, fire bricks etc.

Project Associates. M. A. Biswas and M. Qudrat-i-Khuda.

4. (ii) GLAZING OF CERAMIC ARTICLES AND MASKING THEIR UNDESIRABLE NORMAL COLOURS: Investigations have been carried out to produce opaque glazes of ceramic bodies, which normally develop buff or yellow colours on firing, and promising results have been obtained. Attempts have also been made to mask the undesirable colour of fired articles obtained from clays (particularly those containing higher proportions of iron) by the incorporation of suitable chemicals.

Further studies in this direction are in progress.

Project Associates: N. Ahmed and M. Qudrat-i-Khuda.

5. EXAMINATION OF CHROMITE MINERAL: Chromite ore of West Pakistan is exported to foreign countries as it is mined. Because of the national requirement of potassium dichromate, we have examined this material for its conversion in to this chemical. The chromite is composed of chromic oxide 41.80%, ferrous oxide 16.87%, alumina 14.60%, silica 18.40%, magnesia 7.10% and calcium oxide 0.75% and it dissolves in 89% orthophosphoric acid, yielding a solution of mixed metal phosphates. The silica from this solution is easily separable.

A preliminary study on the separation of chromium as complex phosphates has been made by using ion-exchange resins and it has been observed

that at a given concentration of phosphoric acid, about 90% of chromium and 10% of iron go into the anionic complex, leaving behind all other metals in the cationic state. Studies on the preferential separation of chromium from this mixture of phosphates are under progress.

It has also been observed that our chromite fuses at a fairly low temperature when heated with an alkali bisulphate, and a solution of the metal sulphates can easily be obtained by treating the fused mass with a dilute solution of sulphuric acid. Investigations are under way to obtain the preferential separation of chromium from this solution by applying ion-exchange techniques, and the preliminary results are promising.

Project Associates: M. A. Haroon, M. A. Biswas and M. Qudrat-i-Khuda.

FOOD RESEARCH

1. Utilisation of Coconut Proteins: The fresh undried coconut kernel contains 27.72% of oil, 2.8% of protein, 5.15% of fibre, .21% of reducing sugar, 4.23% of sucrose, 2.81% of starch, together with small quantities of minerals. When the oil is separated by a solvent, the protein can be obtained in a form suitable for human consumption. The separation however, is not easy, because some of it remains in the oil which could be removed only by repeated washing. Other methods of separation are now being investigated.

Project Associates: M. Qudrat-i-Khuda, B. D. Mukherjee and N. A. Khan.

2. Amlaki (Phylanthus emblica) as a food: It was found that locally available "Amlaki" contained a very high percentage of vitamin C. In the separation of the tannin, gelatin, hide power, tikernose, pectin 1% solution appear to be helpful. Amlaki seed oil (17 % of the kernal) was found to contain linolenic acid 9.6%, linoleic acid 46.2%, oleic acid 25.4% and stearic acid 5.4%, palmitic and other acids in traces.

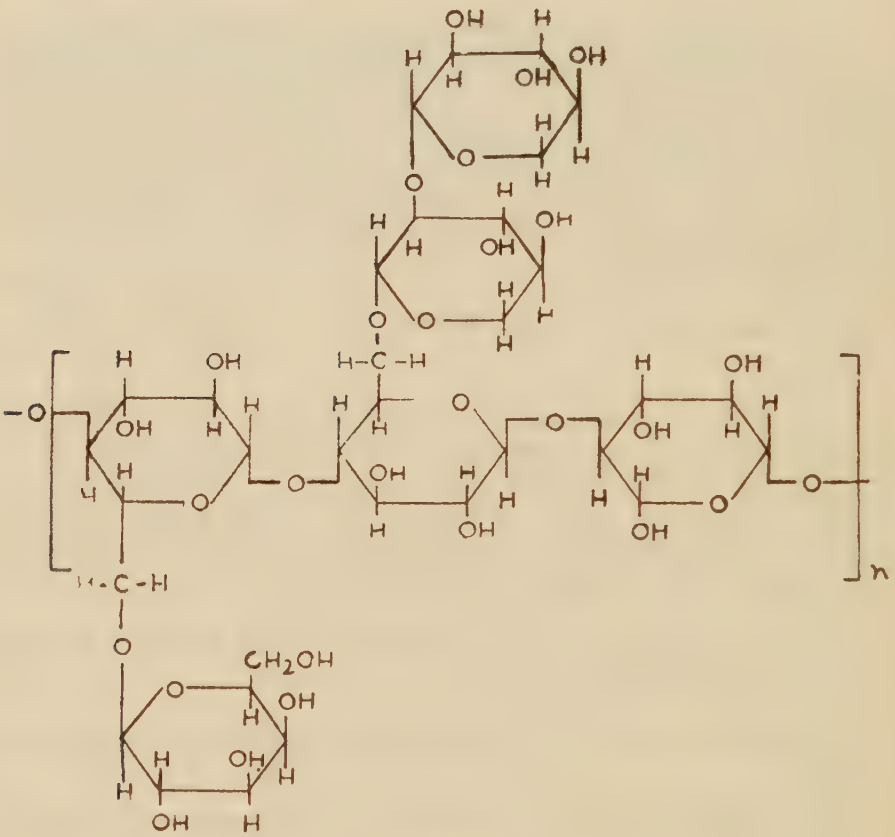
Sweet preparations such as morabba and syrup with high vitamin C have been made for testing.

Project Associates: M. Qudrat-i-Khuda, B.D.Mukherjee and N.A. Khan.

3. Examination of Tamarind of East Pakistan: Tamarind is available here in a fairly large quantity. A systematic study of the fruit and the life cycle of the tree has been made with emphasis on its biochemistry and physiology. The fruit consists of outer shell, pulp, seed and some fibre. The seed consists of the testa and the kernel. All these different constituents have been examined with interesting results.

From the pulp about 3% of potassium bitartrate, 8.9% of tartaric acid, 2.5% pectin and 2.3% of sugar have been isolated along with some pulp residue. The seed testa has yielded a dye and also a bacteriostatic component which appears to be quite resistant to mould formation. The seed kernels yield about 65% of a new polysaccharide, 19% of protein and about 6% of an oil. This new polysaccharide is not starch but is capable of giving pectin-like jelly which appears to be a very suitable sizing material.

In concentrations of 1%, 5% and 10%, it make quite good edible jelly. When the protein is separated by a special technique, developed here, the polysaccharide obtained has been called Tikernose and it has been given a configuration as follows:



TIKERNOSE

This tikernose is not hydrolysed like starch by ordinary enzyme, but only a specific enzyme, which we have called tikanase and which was obtained from germinating tamarind seeds, appears to produce hydrolysis of tikernose at a temperature of 37—38°C. at pH 4.5.

Project Associates: M. Qudrat-i-Khuda, B.D. Mukherjee and N. A. Khan.

4. Biochemical Studies on East Pakistan Fish and Exploration of the Mechanism of their Spoilage: In an effort to determine the suitability of different species of fish of East Pakistan for preservation purpose, the mechanism of their spoilage has been studied. Measurement of iodine

absorption values indicated a great increase of these values during storage of fish. Comparatively the air-breathing species showed a larger increase than the non-air breathing ones. The titratable acidity values, on the contrary, showed a decrease during storage and these maintained a reciprocal relationship with the increase of the iodine absorption values.

The total dehydrogenase activity in the fresh fish was found negligible but on storage the enzymes elaborated the activity and this is stronger in the case of air breathing ones. The increase in activity during storage maintained direct relationship with the fall in acidity upto a certain limit. Measurement of tyrosine during storage has shown an increase of its value in fresh water fish. Further it was noted that ecological behaviour influences to a great extent on the spoilage characteristic of fish as measured by tyrosine values. In determining the part played by the visceral contents in causing the spoilage, it has been observed by measurement of total dehydrogenase activity that spoilage of the fish meat on storage occurs partly by visceral autolysis. Regarding the part played by the bacteria harboured on the body of the fish, it was interesting to note that although fresh scaly fish harboured more bacteria in all parts of the body than the non-scaly one, yet on storage the tissues of non-scaly one harboured more bacterial population.

The measurement of cholinesterase activity revealed that air-breathing species elaborate more actively than the non-air breathing ones and this is perhaps due to constant nerve impulsation in the air breathing ones.

Publication:—

(1) Mechanism of Fish Spoilage—Part I, by M.Q. Khuda, H.N. De, and J.C. Debnath, Pakistan Journal of Scientific and Industrial Research, 2, 217.

(2) Do. Part II, by M. Qudrat-i-Khuda, H. N. De and N. M. Khan, Pakistan Journal of Scientific and Industrial Research Vol. 3, No. 1 (1960).

(3) Do. Part III, by M. Qudrat-i-Khuda, H. N. De and N. M. Khan, Pakistan J. Sci. Ind. Research, Vol. 3, No. 2, (1960).

5. Researches on Ascorbic Acid in Vegetable Products: A series of investigations have been undertaken to evoluate the ascorbic acid content of different vegetable products available in this region and their relationship with the different plant pigments in its co-existence. The green chlorophyll-rich vegetables contained 2 to 21.8 percent (on wet basis) of the total ascorbic

acid, of which dehydroascorbic acid constitutes 4 to 56 p.c. depending on the nature of the product. In assessing the influence of the nature of utensils used for cooking of these vegetables on the loss of ascorbic acid during cooking, it has been noted that loss on cooking is nearly 64 to 66 p.c. for all types of utensils whether aluminium, iron and earthen ones.

While exploring the co-existence of ascorbic acid with the plant pigment it has been noted that it is concentrated in greater quantities in these vegetables where the anthocyanin pigments are present. Thus red skin potato and sweet potato were richer in ascorbic acid than the white skinned ones. Detailed study of the co-existence of ascorbic acid with the anthocyanin pigments has been made with red skinned rat-tail radish at the various stages of growth. Analysis of the different samples showed that ascorbic acid concentrate in both pigmented and non-pigmented portions increased with the progress of growth of the plant. At all stages the ascorbic acid was concentrated more in the pigmented portion than in the non-pigmented one. Separate examination of the skin and of the flesh showed that the acid is concentrated more in the pigmented skin.

Spectrophotometric study of the alcoholic extract of the different portion of the skin showed that the white non-pigmented portion contained the leuco anthocyanin where the ascorbic concentration is low. The pigmented portion contained pelargin and cytin and ascorbic acid is concentrated in greater quantities along with these pigments. This suggests a close relationship between anthocyanin and ascorbic acid in the terminal oxidation process in plants.

Further researches are now in progress in order to throw light on the actual role of anthocyanin pigments in the plant conservation of ascorbic acid.

Publication: By M. Qudrat-i-Khuda, H. N. De, M. A. H. Sharif and N. Huque Mia, Pakistan Journal of Scientific and Industrial Research (1959.)

6. Exploration of New Sources of Starch in East Pakistan: The starch from rhizomes of *Curcuma zedoaria*, which is being used in this region as Shoti, has been thoroughly studied with respect to its suitability for edible and industrial uses by comparison against those extracted from other sources such as Sweet Potato and Cassava. The rhizomes of *Curcuma zedoaria*, (Shoti), tuber of *Manihot utilissama* (Tapioca) and root of *Ipoemea batata* (Sweet Potato) yield on an average total starch of 64.1, 68.4 and 69.4 p.c. respectively on dry basis. Actual starch content of the raw starch

determined by calcium chloride dispersion method was found to be 93.8, 96.4 and 94.0 p.c. respectively for the above three varieties of starches on dry basis. Tuber of *Manihot utilissamas* thus appeared to be economically better source of starch as compared to the other two. On evaluating the amylose contents of these starches by potentiometric titration with iodine, it was noted that Shoti starch possesses more amylose level (34 p. c.) than the Sweet Potato and Tapioca starch has a lower amylose content of 18 to 20 p.c. This high level of amylose and consequently low level of amylopectin makes the Shoti starch unsuitable for sizing purpose. This suitability of Shoti starch for sizing purpose was further ascertained by observation of its high production of reducing sugar only by boiling and for this generation of free reducing sugar Shoti starch is apt to undergo fermentation when applied as sizing material. The other two starches do not show any evidence of production of reducing sugar by such boiling process. Along with the determination of amylose content, the spectrophotometric study of the colour formed by these starches with iodine has also been carried out and their minimum transmission values at the peak absorption wave length of $610 \pm 5 m\mu$ was found to be 30.4, 38.5 and 41.8 p. c. respectively for Shoti, Sweet Potato and Tapioca starches. These values maintained reciprocally linear relationship with the amylose content; and also with the size of the granules which were found to be 33.8, 17.5 and 11.0μ respectively for the above three starches. Microscopic examination in transmitted light showed elliptical shape for Shoti starch, round and plygonal shape for Sweet Potato starch and round and kidney shape for Tapioca starch. Under polarised light the hilum in Shoti starch was found to be eccentric whereas it was centric in case of the other two. Digestibility study with saliva and taka diastase revealed that like other starches cooked starch from the above sources were better digested than the raw ones. Further, saliva effected more digestion than taka diastase. Although the degree of hydrolysis of both Tapioca and Shoti starch was almost the same, yet the rate of increase of the degree of hydrolysis from the zero hour level is highest in the case of Tapioca starch.

Publication: M. Qudrat-i-Khuda, H. N. De, N. M. Khan, S.M. Haque, M. Yasin, N. Huque Mia and M. Rahman. Pakistan J. Sci. Ind. Research (1960).

7. BIOGENESIS OF STARCH IN RED SKIN AND WHITE SKIN POTATO:-Two varieties of potato—red skin and white skin—grown in this region have been studied with respect to the synthesis of starch in these potatoes and the evaluation of their different physical and chemical characteristics. Analysis of the starch level showed an increase from 11.4 to 16 p.c. in case of white skin variety and from 6.6. to 11.5 in case of red skin variety with the process of growth from the lowest size of 1 cm. to the highest size of 2.5 cm. in diameter.

Reverse results were however noted in the case of their reducing sugar and total sugar contents.

In evaluating the amylose contents of their starches, it was interestingly noted that although red skin variety possessed less starch at all levels of its growth, yet the amylose content of its starch was more (26 to 29 p.c.) than that of the starch of white variety potato (24 p.c.) The spectrophotometric study of the iodine colour complexes formed with these starches showed that although the absorption peak in all cases arrives at 610 m μ yet their p.c. transmission values were considerably different and this is mainly due to difference in the amylose contents in the two varieties of potato.

Project Associates: M. Qudrat-i-Khuda, H. N. De, M. Haque, M. Yasin, N. Haque and M. Rahman.

8. Preparation of Protein-rich Diets: To improve the protein nutrition of school children some protein-rich formulated diets in the form of vermicelli have been prepared in this laboratory by utilisation of protein-rich sources like fish and egg available in the country. Aneconomic method for the preparation of fish flour and whole egg powder and defatted egg powder has been developed. The products obtained by this process possess long shelf life. The fish flour prepared for this purpose contained 80 p.c. protein on dry basis. For improvement of the calcium level of the poor rice diets, the small fish including the bones and head was utilized in the powder form. The above fish flour and egg powder (defatted) by combination with Sweet Potato starch in varying proportion were made in to vermicelli with protein contents varying from 7 to 43%. These vermicelli, even when stored for ever two years in this humid climatic condition, did not show any evidence of spoilage by organoleptic test.

Some of the samples of the vermicelli were seasoned and deodorised and by the study of the total bacterial counts in these samples it was noted that the seasoned and deodorised samples harboured less bacteria (11 to 15 thousands) per gm. dry wt. than the unseasoned and non-deodorised one (41 to 87 thousands). These results indicate the antibacterial effect of seasoning and deodorisation which curtail the probablity of spoilage by microorganisms. Arrangements are now being made to study the nutritive value of the proteins of these products by experimentation on animals and human subjects.

Project Associats: M. Qudrat-i-Khuda, H. N. De, N. M. Khan, J. C. Debnath and J. K. Jowardar.

9. Biochemical studies on Traditionally Processed Fish Products: It has been estimated that nearly 0.6 million ton of fish is preserved by drying

in open sun in regions like Cox Bazar, Sylhet and Khulna, where fish is available in considerable quantity but cannot be despatched to the inland market due to the lack of quick transport facilities. A determination of the proximate composition of these traditionally processed products locally called Sukti fish gave an average figure of 67.1 to 84.3 p. c. protein and 6.7 to 24.0 p.c. moisture, 4.0 to 7.6 p.c. fat and 4.3-12.2 p.c. ash. It was interesting to note that various samples of Sukti fish collected from the same pit possessed varied content of moisture and this is perhaps due to individuality of the species which influences the retention of moisture in the spoiled tissues.

In assessing the quality of these Sukti fish by comparison against the fresh and spoiled fish by application of the spoilage tests mentioned before, it was found that iodine absorption values in case of Sukti fish ranged from 21-44 cc N/100 12, whereas the same for fresh and spoilage ones was found to be 26-46 c. c. and 53-10 c.c. The titratable acidity values of the Sukti fish (77-57 c. c. N/100 Na_2Co_3) was comparable with those of fresh (21-48 c.c.) The spoiled fish showed a very low value of titratable acidity to the range of 5-11 cc N/100 Na_2Co_3. Bacterial count determination showed a very low population of 47-120 thousand per gm. dry wt. of Sukti fish, as compared to 300-2800 in case of fresh fish and 9,000-32,000 in the case of spoiled fish.

The above tests thus indicate that Sukti fish when prepared by traditional sun drying process will not have undergone any appreciable spoilage as evaluate by the above tests. These may be made to standard products under controlled and sanitary condition.

Project Associates: M. Qudrat-i-Khuda, H. N. De, N. M. Khan, J. C. Debnath and J. K. Jowardar.

10. Storage factors and other aspects of Parboiled Rice: Parboiling of paddy is being practiced in this region as means for storage of the rice for a longer period with less attack by pests and insects. The long storage life of the parboiled rice has been found to be due to the inhibition of the amylose and lipase activities of the grains. Consequently, the auto-amylytic and autoliplytic activities in the grains are checked, decreasing the production of reducing sugar and free fatty acids and producing an unfavourable medium for the growth of the organisms.

This is evident from the reducing sugar values which in parboiled rice is present to the extent of nearly 0.08 mg. p.c. in ordinary state and reaches to 120 mg p.c. after incubation for 4 hours. In raw rice the value increased from 0.2 p.c. to 35 mg. p.c. after incubation.

In exploring the water absorption capacity of the parboiled rice as compared to that of raw one during the process of cooking for preparation of meal it has been found that parboiled rice absorbs only 50 p.c. water whereas raw one absorbs 70 p.c. of the same. The higher absorption of waters in raw rice effects an increase in length by 60 p.c. and in breadth by 40 p.c. whereas in case of parboiled rice less increase of 32 p.c. in length and 24 p.c. in breadth was noted.

In exploring the cause of viscous nature of the gruel thrown after cooking raw rice, it has been observed that raw rice gruel contains nearly 9 mg. starch per p.c., whereas that of parboiled rice contains 4 mg. starch. Moreover, it has been calculated that the average loss of starch in the gruel from the raw rice is 1.2% whereas that from parboiled one is nearly 0.8 p. c.

Along with the above studies, the degree of dextrinisation of starch during parboiling of paddy and cooking of parboiled and raw rice and change in the amylose and amylopectin contents have been investigated. A new spot test based on the soaking of the filter paper strip with stearic acid and alcohol, drying the same, adding a minute drop of the starch solution and ultimately development of the colour by addition of iodine. By this technique coloured rings of different intensities are formed which aid in the assessment of dextrinisation. The starch from parboiled rice imparts a deep blue colour in the inner ring and light violet colour in the outer one whereas the starch extracted from the cooked meal of the same sample imparted violet colour in the central ring and pinkish colour in the outer ring. Similar change was also noted in case of starch extracted from raw rice and its cooked product.

Further research is in progress for the perfection of this technique so that this may be quantitatively applied for the measurement of the degree of dextrinisation due to parboiling and cooking of rice for preparation of meal as this degree of dextrinisation ultimately influences digestibility by salivary amylase and parcreatic amylase.

Project Associates: M. Qudrat-i-Khuda, H. N. De, J. C. Debnath, and M. Rahman.

11. Storage of Wheat and Preparation of Combined Rice- Wheat Grain: The parboiling process as proctced in case of paddy has been applied for the storage of wheat as this grain is also much infected by insects and pests in this humid region.

Samples exposed to steam for 10, 20 and 30 minutes were analysed for the study of the auto-amylytic activity and it has been noted that unstea-

med and 10-minute-steamed samples contained 0.28 and 0.25 percent reducing sugar whereas 20-minute and 30-minute-steamed samples contained about negligible quantities of reducing sugar. On incubation the values for the unsteamed, 10-minute-steamed and 20-minute-steamed products reached to 0.67,0.60 and 0.12 percent whereas 30-minute-steamed sample showed no generation of reducing sugar indicating complete absence of amylase activity in this sample.

Examination of these samples on storage for 2 months showed complete absence of larvae and adult insects of *Tribolium castaneum* in 30-minute-steamed sample. In 20-minute sample only larva was present whereas in raw and 10-minute-steamed samples both larvae and adult insects were found in abundance.

"Chapatti" prepared from the sample treated for 30 minutes by steam could be well preserved without any deterioration. This 30-minute-steamed sample although may not be suitable for bread making due to absence of amylase yet it is suitable for the making of chapatties for household consumption.

In order to popularise the consumption of wheat among the rice eaters a synthetic rice-wheat grain has been prepared by combination of the parboiled and 30-minute-steamed wheat. The product contained nearly 9 percent protein and may be served as a ready meal after dipping in boiled water for 10 minutes only. A similar product was prepared by combination with unsteamed wheat. After the storage of these samples for six months in the laboratory condition, it has been observed that the grain prepared from steamed wheat was not at all in a deteriorated state or attacked by insects. The grains prepared from unsteamed wheat, however, were completely converted to powder form due to attack by insects. Further research is now in progress for assessment of the digestibilities of the protein of such synthetic grains.

Project Associates: M. Qudrat-i-Khuda, H. N. De, and N. M. Khan.

12. Mechanism of Banana Ripening: East Pakistan produces annually 1.4 million tons of different varieties of banana. The most common variety is *Amrit Sagar* which is largely preferred by the consumers because of its flavour and sweetness. A large portion of this banana gets spoiled during storage and transport either due to over ripening or due to frictional wound caused on their bodies. During transport and storage, the climateric and post-climateric phases pass so quickly that within a very short period over-ripening starts and this causes damage to a whole batch. Refrigeration and other costly methods have been developed to delay this process of ripening. But for internal transport of this fruit in East Pakistan it is

necessary to develop some other economical processes by which this over-ripening and the damage may be better controlled without affecting the nutritive value of the banana. This will be possible only when the mechanism of chemical changes occurring under the influence of different enzymatic processes of ripening is known. A series of experiments have, therefore, been undertaken in this line. In the first series of investigations the total activity of all the dehydrogenases involved in the breakdown of starch to sugar and partly to acid and CO_2 through glycolysis and Kreb's cycle oxidation have been determined on different batches of bananas during the process of ripening at ordinary room temperature. One hand with a few bananas was allowed to ripen while attached to stalk and another was kept detached from the stalk. The total dehydrogenase activity of the peel and pulp from the top, bottom and middle protions of each sample was studied for a period upto the post-climateric phase. The results may be summarised below.

(*i*) The dehydrogenase activity showed sharp increase with the progress of ripening upto 3rd day in the case of the batch attached to the stalk. At this period the peel became just yellow in colour. On 4th day there was slight decline and on the 5th day there was again a rise in the activity. At this stage the banana became overripe and the peel showed brown colour.

(*ii*) In case of 2nd batch detached from the stalk, ripening was slow and maintained parallel relationship with the enzyme activity which was lower as compared to that in the batch attached to the stalk. In this batch the full ripening did not occur even after 5th day.

(*iii*) In both the batches and at all stages of ripening the peel showed comparatively larger enzyme activity than the pulp. It was further noted that maximum enzyme activity in both the peel and the pulp was located at the tip and minimum towards the stalk.

The results are shown in the table and the time of decolorisation of M. B. as indicated in the table should be considered as inversely proportional to the activity.

Further work to study the activity of individual dehydrogenase is in progress.

Project Associates: M. Qudrat-i-Khuda, H. N. De and N. M. Khan.

Table showing the total dehydrogenase of banana (Amrit Sagar) in the process of ripening

Time of storage (Days)	With Stalk					Without Stalk				
	Colour	Peel or Pulp	Time of Discharge of M. B.			Colour	Peel or Pulp	Time of Discharge of M. B.		
			Tip	Middle	End			Tip	Middle	End
0	G	Pu	Decolorisation after 8 hrs.			G	Pu	Decolorisation after 8 hrs.		
		Pe	Decolorisation after 6 hrs.				Pe	Decolorisation after 6 hrs.		
1	G-Y	Pu	2-20 min	3-40 min	4-10 min	G	Pu	Decolorised after 6½ hrs.		
		Pe	1-10 ,,	1-40 ,,	2-34 ,,		Pe	Decolorised after 5 hrs.		
2	G-Y	Pu	0-52 ,,	1-20 ,,	1-40 ,,	G-Y	Pu	3-10 min	3-40 min	4-54 min
		Pe	0-42 ,,	1-2 ,,	1-24 ,,		Pe	2-2 ,,	2-30 ,,	3-10 ,,
3	Y	Pu	0-32 ,,	0-50 ,,	1-3 ,,	G-Y	Pu	2-40 ,,	3-18 ,,	3-34 ,,
		Pe	0-20 ,,	0-32 ,,	0-48 ,,		Pe	1-48 ,,	2-10 ,,	2-30 ,,
4	Y	Pu	0-42 ,,	0-52 ,,	0-10 ,,	G-Y	Pu	2-12 ,,	2-48 ,,	3-2 ,,
		Pe	0-31 ,,	0-39 ,,	1-3 ,,		Pe	1-4 ,,	1-32 ,,	1-58 ,,
5	B-Y	Pu	0-22 ,,	0-31 ,,	0-48 ,,	Y	Pu	2-2 ,,	2-10 ,,	2-32 ,,
		Pe	0-10 ,,	0-15 ,,	0-18 ,,		Pe	0-48 ,,	0-53 ,,	1-6 ,,

Pu denotes = Pulp
Pe ,, = Peel
G ,, = Green colour
G-Y ,, = Greenish Yellow colour
Y ,, = Yellow colour
B-Y ,, = Brownish yellow

13. PREPARATION OF BANANA FLOUR: In this humid region, a large number of infants and adults inherit a delicate digestive capacity and so they suffer from different diseases due to the temporary derangement of stomach. For such persons starch which may be easily digested is best suited. It has been reported by various workers that banana flour in the form of light gruel serves as medicated diet for such patients suffering from stomach derangement.

A new and economic process has been developed in this laboratory by which banana has been made to a flour form. The product prepared is perfectly white in appearance and stores well without any deterioration. The composition of the product is given below.

Table showing composition of Banana Flour

Moisture p. c.	Protein p. c.	Reducing sugar p. c.	Non-reducing sugar p. c.	Strach p. c.	Fat p. c.	Ash p. c.
9.12	3.58	0.38	0.52	74.54	0.98	3.98

From the results it would appear that the starch content of the product is much higher than reported else where (67. p.c.).

The storage capacity of this product was assessed by the determination of reducing sugar after incubation in water for 4 hours. It was noted that reducing sugar value did not show any appreciable change through such incubation. This indicates the inactivation of amylase due to processing operations developed in this laboratory.

Project Associates: M. Qudrat-i-Khuda, H. N. De, and N. M. Khan.

LEATHER RESEARCH

1. Utilisation of Hide cuts and Fleshings: Glues and gelatin were prepared from the fleshing of the hides and skins which were kept under lime liquor for a certain period. The materials were washed, cleaned, delimed and the pH was brought within the range of 4-4.5 by the use of NH_4Cl and HCl or boric acid. Cooking was done on water bath for four hours. The different extracts were collected and evaporated on water baths under reduced pressure and finally glue or thin sheets of gelatin were obtained.

This appears to be a good method for disposing off part of the slaughter house waste.

Project Associates: M. Qudrat-i-Khuda and A. K. M. Moslem Ali.

2. Fur Leather: Raw goat skins were fleshed, washed and degreased. Then it was tanned. Tanning liquors used consisted of aldehyde, chrome and alum. Basicity of the chrome liquors was carefully controlled. A suitable organic mixture was applied to get the furs soft and smooth. Work is in hand to use indigenous vegetable tannins for some skins.

Project Associates: M. Qudrat-i-Khuda and A. K. M. Moslem Ali.

3. Transparent Leather (Pseudo Plastic): Delimed pelts were carefully treated with a polyhydric alcohol and fish oil. On drying at a temperature below 50°C. transperant leather was obtained. Primarily it had some major defect. It was stiff and could not stand water. These drawbacks have now been overcome to some extent and after repeated trials soft and water repellant transparent leather has been produced. Further work is in progress.

Project Associates: M. Qudrat-i-Khuda and A. K. M. Moslem Ali.

4. Patent Leather: Efforts are being made to develop a process for making patent leather. For this purpose a varnish was prepared and applied on the leather which become quite glossy and impermeable to water but the film formed is a bit cracky. This defect is now being attended to for remedying.

Project Associates: M. Qudrat-i-Khuda and A.K.M. Moslem Ali.

WEST REGIONAL LABORATORIES

ORE DRESSING AND METALLURGY

1. Fluxes: (*a*). General purpose Brazing Flux.

In continuation of the previous work on this project (Quinquennial Report, 1953-58, p. 104), further improvement in the quality of the flux was affected. The composition now formulated adheres promptly to the hot brazing rod and spreads evenly on the joining surface. It compares well in all respects with the imported flux.

Patent: Pakistan Application No. 271/60, dated 4-4-1960 "Preparation of a brazing flux for use at high temperatures", by A. H. M. Ziaul Haq, M. G. Ali Biswas and Karimullah.

(*b*). Flux for joining Aluminium and its Alloys at Different Temperatures: Work has been carried out preparing fluxes which are suitable for use in hard soldering, brazing or welding of aluminium and its alloys. One of the above fluxes for joining aluminium is well suited for the newly developed process of "Thesscal" and soldering. The above fluxes contain low amounts of halides of lithium and cadmium, and they compare well in cost and performance with the imported material.

Patent coverage is being obtained and arrangements for leasing out the process are being made.

Project Associates; M. I. Bhatty and M. G. Ali Biswas.

2. Refining of Baluchistan Sulphur Ore: The process for refining sulphur ore described in the Quinquennial Report, 1953-58, consists of boiling the ground ore in a solution of calcium chloride when sulphur melts to form globules which can be separated by sieving and washing. Calcium chloride solution, however, has a very corrosive action on the equipment, whether of cast iron or stainless steel. Experiments were, therefore, undertaken to extract the sulphur from the ore by other more suitable methods.

Solvents like carbon disulphide and kerosine oil were tried but they were not found to be suitable, carbon disulphide due to its non-availability in the country and its high cost and kerosine oil due to the low solubility of sulphur in it. The ore was, therefore, first froth-floated, which increased

the supphur content to 85 per cent. It was then treated with superheated steam, when molten sulphur could be separated from the rest of the gangue material or it could be filtered through a filtering medium which gave pure sulphur. Further experiments to increase the yield of sulphur are in progress.

Project Associates: Aziz Ahmad, Iqbal Ahmad and Karimullah.

3. PREPARATION OF LIMONITE COMPOSITION: As mentioned in the Quinquennial Report, 1953-58, considerable quantities of limonite are needed by the P. I. D. C. for removing H_2S from the gas obtained by gasification of Makerwal coal. The limonite composition obtained by mixing calculated amounts of commercial ferrous sulphate and lime was found to be suitable on a laboratory scale. When tried by the Daudkhel Fertilizer Factory, under factory conditions, the results were reported to be satisfactory. Indigenous iron ores and clays rich in iron oxide, were also tried, but their absorbing power for H_2S was, found to be very low. Attempts are being made to increase their absorbing property by the activation of these ores and clays.

Project Associates: Aziz Ahmad, Iqbal Ahmad and Karimullah.

4. PRUSSIAN BLUE OF DIFFERENT SHADES: Various shades of Prussian blues such as bronze-blue, non-bronze-blue, super non-bronze blue, Chinese blue and Milore blue, have been prepared using sodium or potassium ferrocyanides, indigenous sulphate, ammonium sulphate and a suitable oxidizing agent. The shades obtained compare favourably with the imported Prussian blues.

Patent coverage is being obtained, the process is being leased to a firm for exploitation.

Project Associates: A. Rehman Chughtai, Iqbal Ahmad and Karimullah.

5. SILICA AND ALUMINA GELS: Inorganic gels like those of silica and alumina have attained, in recent times, great importance for dehydrating and deodourising of gases, absorption of hydrogen sulphide etc. Silica gels are also used as cigarettes filter tips.

The following types of gels were prepared and tested for their absorbing properties:-

i) Colourless silica gel.

ii) Silica gel containing an indicator which is blue when it is anhydrous and which becomes pink when it absorbs moisture.

iii) Gel containing iron oxide.

iv) Alumina gel.

The gels have been prepared from locally produced water glass, sulphuric acid and alumina. The first kind of gel has been used for deodourising of gases like carbon dioxide obtained in the fermentation industry, the odour of which has been totally eliminated when the gas is passed through the silica gel. The second type of gel is quite efficacious as a desiccating agent and can very easily replace calcium chloride, sulphuric acid or phosphoric acid. Silica gel of the third type has been used for the elimination of hydrogen sulphide from a mixture of gases, while the fourth type can be used as an efficient catalyst and decolourising agent where ordinary alumina does not give very good results.

Project Associates: A. Rahman Chughtai, Iqbal Ahmad and Karimullah.

6. Production of Aluminium Acetate: A local firm approached these laboratories for helping them in the production of aluminium acetate, which finds use for water proofing of fabrics. It is being imported at present and is thus a strain on the foreign exchange of the country.

Aluminium as such is not reacted upon by acetic acid, but when its surface is suitably activated, the reaction with acetic acid is quite vigorous. Aluminium acetate so formed gets precipitated from its solution when kept for some time at a high temperature. A suitable stabilizer, however prevents this precipitation. The material prepared in the laboratory has been found to compare favourably with the imported material, and the process has been leased out to the local firm.

Patent: Pakistan Application No. 634/60 "Production of soluble acetates of aluminium," by A. Rahman Chughtai and Karimullah.

7. Copper powder—Graphite Brushes: In the medium to heavy electrical machinery, metal graphite brushes are used for collecting current from the moving parts. Since the characteristics of both metals and graphite, the former being a conductor of electricity and the latter acting lubricant, are to be retained in this particular type of product, it is made by as a solid Powder Metallurgy only.

Using laboratory-prepared copper powder and imported graphites, several sample brushes have been prepared. These brushes have, on comparison with imported products, indicated promising results.

Project Associates: M. I. Bhatty and M. G. A. Biswas.

8. LITHARGE AND RED LEAD: There is an appreciable demand in the country for good quality litharge and red lead in the manufacture of storage batteries and paints. These chemicals have been prepared on a laboratory scale from imported raw materials, and an attempt has further been made for manufacturing them on a pilot plant scale. For this work, a small reverberatory furnace has been designed and constructed. Studies are being continued for obtaining products of the required quality.

Project Associates: A. Rahman Chughtai and Karimullah.

9. BRIGHTENING, ANODIZING AND COLOURING OF ALUMINIUM SURFACE: Investigations were carried out to produce bright aluminium surfaces. Both chemical and electrochemical methods were employed for the purpose. To preserve the brightness of the surface so obtained, they were successfully anodized. The anodized surfaces retained their brightness after exposing to weather for many months.

The anodized surfaces were coloured with a number of dyes. Most of the colours so produced were resistant to light and heat.

Project Associates: Mohammad Akram and Karimullah.

10. STORAGE BATTERY PLATES: A local factroy approached the laboratories for help in improving the quality of the storage battery plates produced by them. The red lead provided was of accumulator grade while the litharge was of very poor quality as it contained antimony and iron along with other impurities. Removal of antimony being uneconomical, attempts were made to improve the quality of the plate by the addition of certain chemicals. Plates produced according to some of the formulations were quite satisfactory.

Project Associates: Mohammad Akram, M. K. Bhatty and Karimullah.

11. ULTRAMARINE BLUE: Good quality ultramarine blue was obtained with imported china clay which, unfortunately, is not yet reported to be available in the country. Large quantities of ball clay are, however,

available. Attempts were made to use them in preparing the blue, but the results were not encouraging. The work of purifying the clays is in hand.

Project Associates: Khalid Masood and Iqbal Ahmad.

12. Chemicals from Dhariala Brine by Solar Evaporation: It has already been shown that the Dhariala brine in the Jhelum District is a rich source of salts like potassium, magnesium, calcium chlorides and bromine. (See Quinquennial Report 1953-58, page 102). In order to recover these chemicals from the brine by the usual techniques, very expensive items of equipments such as boiling pans, crystallizers, filters, thickners, centrifuges, pumps, vacuum crystallizers, chlorinating towers, debrominating towers, rotary driers, conveyors and boilers etc., are needed. This would need a heavy layout of capital.

Since Dhariala is situated in a semi-arid zone of West Pakistan where solar energy is plentifully available, and the bore hole is located on a flat plateau, it was, therefore, considered desirable to study whether these chemicals could be recovered from the brine by solar evaporation on this flat plateau. Initially these studies were undertaken on a laboratory scale. When the density of the brine rose from 30° Be to 32° Be, a crop of crystals was obtained which were mainly sylvinite. The second crop was obtained when the density rose from 32° Be to 38° Be; this was mainly carnallite. The solution with a density of 38° Be to 40° Be gave a mixed fraction of carnallite and free magnesium chloride. Sylvinite and carnallite were separated into their components by use of judicious amount of water. It can, therefore, be seen that many components of Dhariala brine can be usefully separated with the help of solar energy.

Further work on conducting these experiments on a larger scale is in hand.

Project Associates: Naseer-ud-Din, Iqbal Ahmad and Karimullah.

13. Water Proofing Materials: Experiments, in the laboratories have shown that aluminium acetate can be prepared in the country. According to a report from a factory, the solution of aluminium acetate prepared in our laboratories has been shown upto the required standard. The storage quality of our aluminium acetate is, however, still not upto the mark because on keeping for more than 15-16 days it forms basic aluminium acetate which is not desirable. Studies were pursued successfully to stabilize the solution with the help of various stabilizers.

The other chemical composition known as "Waxol" which is used in association with aluminium acetate for complete water proofing has also been

prepared in our laboratories. This material which contains paraffin wax with suitable stabilizer has been tested successfully by an industrial concern.

Project Associates: A. R. Chughtai, Ehsan Ali, M. H. Hashmi and Karimullah.

OILS, FATS AND WAXES

1. Investigations on Trombidium tinctorum Linn. (aroos-ul-arz): The species *Trombidium tinctorum* Linn. (Local name bir bohiti) belongs to the members of the family *Trombidium* and is known as scarlet mites to the horticulturists. Its phylum is *Arthropoda,* order *Acardia* class *Arachnida.* Although it has been wrongly classified as cochineal insects by several authors, the members of this class are, in fact, spiders. The mites were identified as *Trombidium tinctorum* Linn. by Akhtar[1] and Evans.[2]

Interest in the present chemical investigations has been evoked by the fact that the mites in the dried form are administered in the indigenous system of medicine for respiratory and reproductive ailments. The mites are reputed to possess nerve stimulating properties in Ayervedic and Unani Schools of Medicine. Their colouring matter is reported to possess sedative and anti-spasmodic properties. It is also useful in whooping cough, neuralgia, etc.

The mites, plentifully met with during the rainy season, were hand-picked and preserved in rectified spirit for investigation.

Part I—The composition of the Fat of *Trombidium tinctorum* Linn.

The composition of the insect fat has been found as follows:-

Glycerides of

1.	Butyric acid	=	2.48%
2.	Iso-valeric acid	=	1.34%
3.	Caproic acid	=	0.68%
4.	Lauric acid	=	4.12%
5.	Myristic acid	=	3.93%
6.	Palmitic acid	=	24.25%

1. S. A. Akhtar (West Regional Laboratories, P.C.S.I.R., Lahore), Private communication.

2. G. O. Evans (Dept. of Zoology, Arachnida, British Museum, Natural History, Coromwell Road, London, S.W. 7). Private Communication.

7. Stearic acid = 9.05%
8. C_{14} unsaturated acids = 6.09%
9. C_{16} „ „ = 32.33%
10. C_{18} „ „ = 13.07%
11. $C_{20\text{-}22}$ „ „ = 2.80%

Publication: Part I—Chemical Constitution of the Fat of *Trombidium tinctorum* Linn. by Shafiq Ahmad Khan, M. K. Bhatty and Karimullah, Pakistan Journal of Scientific and Industrial Research, (1960).

Part II—Chemical Composition of the Non-saponifiable Matter of the Fat of *Trombidium tinctorum* Linn.

The non-saponifiable matter of the fat of *Trombidium tinctorum* Linn. has been studied in detail. It has been found that it contains (1) astacene, (2) cholesterol and (3) docosyl alcohol. The separation, purification and crystallisation of all these substances were carried out according to the standard techniques.

1. *Astacene:*

It has been shown that the red colouring matter in the non-saponifiable matter is a crystalline carotenoid, astacene. The melting point of the pigment is 242-244°C. and that of its acetyl derivative is 235-236°C. The pigment was further characterised by its specific absorption at 500-505 μ. in carbon disulphide.

2. *Cholesterol:*

A white creamy crystalline substance was isolated from the non-saponifiable matter and purified to a definite m.p. That it was cholesterol, m.p. 134°C. was established by the formation of its various derivatives such as acetyl, benzoyl and bromide. Futher the mixed melting points of the substance and its derivatives with authentic cholesterol and its derivatives respectively, established the identity of the substance as cholesterol.

3. *Docosyl Alcohol:*

This is a C_{22} fully saturated alcohol and is wax-like in appearance. The presence of this alcohol was established by determining its melting point, 69°C. and by establishing its chemical characteristics through formation of various derivatives whose m.p's. were also checked as before.

Project Associates: Shafiq Ahmad Khan, M. K. Bhatty and Karimullah.

2. INVESTIGATIONS ON THE INSECT LIPIDS: STUDIES ON THE FAT OF DORISCHA STEBBINGI (MEALY BUGS): An interesting case of a rapidly polymerizing fat has been observed while studying *Dorischa stebbingi* (mealy bugs). These insects are a pest of the mango trees and can be collected in large quantities, during March to May. They yield upto 14% of a yellowish red fat on a wet basis. So far, we have only been able to characterize the fat by determining the various physico-chemical characteristics and the percentage of the solid acids. Liquid acids have yet to be studied and identified. Amongst the saturated acids, mainly palmitic (3.5%) and stearic (4.8%) acids have been characterized. The total composition of the fat will be reported later.

Project Associates: Shafiq Ahmad Khan, Mohammad Ilyas Qureshi, M. K. Bhatty and Karimullah.

3. COMPOSITION OF THE OILS OF SOME MUCILAGINOUS SEEDS: FATS OF *Salvia spinosa* (KANOCHA) AND *Ocimum pilosum* (TUKHM-E-REHAN): The seeds are usefully employed in the cure of dysentary and gonorrhoea. Although the curative properties of the seeds are directly attributable to the mucilaginous constituent, the study of the oils was in itself considered of interest from the point of view of determining the overall composition of the seeds. It may be stated that these seeds have beenfound to contain large amounts of proteins and carbohydrates.

In the present studies, the oils of *Salvia spinosa* and *Ocimum pilosum* seeds have been investigated with a view to elucidating their chemical composition.

The composition of the oils is as follows:-

	Salvia spinosa	*Ocimum pilosum*
Palmitic acid	3.4%	3.3%
Stearic acid	5.9%	6.4%
Oleic acid	43.7%	15.4%
Linoleic acid	33.9%	56.3%
Linolenic acid	12.4%	18.5%

The non-saponifiable matter of the oils is also under investigation.

Project Associates: Shafiq Ahmad Khan, Mohammad Ilyas Qureshi, M. K. Bhatty and Karimullah.

4. COMPOSITION OF THE OIL OF *Asphodelus fistulosus* (PIAZI) SEEDS: Work on the utilisation of Piazi seeds as a food or the application of the seed oil has so far been neglected. The exact composition of the oil was also unknown. This gap had left considerable doubts as to the precise industrial applications to which the oil could be put. Investigations on the composition of the oil have, therefore been carried out. Both the oil and the protein values of the seeds have been studied intensively.

The composition of the oil is as follows:-

Myristic acid	=	0.5%
Palmitic acid	=	5.7%
Stearic acid	=	3.6%
Oleic acid	=	33.1%
Linoleic acid	=	54.9%
Non-saponifiable matter.	=	1.8%

It has been, therefore, shown that the oil is of a drying nature and can be used in paints and varnishes.

Project Associates: Shafiq Ahmad Khan, Mohammad Ilyas Qureshi, M. K. Bhatty and Karimullah.

5. STUDIES ON A STEROL FROM SESBANIA AEGYPTICA SEED OIL: *Sesbania aegyptica*, locally called as 'Janter' belongs to the natural order *Leguminosae*, sub-order *Papilinaceae*. It is found all over the tropical areas of Pakistan and India. Its leaves, seeds and bark are medicinally used in checking diarrhoea and excessive menstrual flow diseases.

Present investigations reveal that *Sesbania aegyptica* oil contains 2.1% of a non-saponifiable matter. A sterol, m.p. 130° has been isolated from the non-saponifiable matter by crystallisation in methanol. Analysis and molecular weight determination of the sterol established the formula as $C_{29}H_{50}O$. The presence of an alcoholic group was confirmed by preparation of acetate and benzoate derivatives of the sterol. The acetate further furnished a dibromide derivative which established the presence of one double bond. The characteristics of the sterol have further been confirmed by the preparation of a digitonide (decomp. p. 220°C.) which is sparingly soluble in alcohol. By liberation of the original sterol from the digitonide, β-orientation of the hydroxyl group has been indicated.

Project Associates: M. A. Chughtai, M. Ahmad, Iftikhar Ahmad, M. K.Bhatty and Karimullah.

6. CHEMICAL INVESTIGATION OF *Paeona emodi* WALL (FAMILY RENUNCULACEAE): This is an erect herb and is commonly found in upper Hazara, Malakand, Khyber and Kurram agencies. The tubers of the herb are medicinally used in uterine and nerve diseases and its seeds are used as purgative and emetic.

Systematic chemical investigations on the tubers of the herb are being carried out. So far (1) salicylaldehyde as essential oil, (2) fixed oil, (3) sucrose and (4) benzoic acid, have been isolated from the drug and identified.

Besides, an amorphous substance has been isolated from the fresh tubers of *Paeonia emodi* which gives green colouration with ferric chloride and a characteristic change at difference pHs. Work on the characterisation of this amorphous substance is in progress.

Project Associates: Nasir-ud-Din Zahid, Iftikhar Ahmad, M. K. Bhatty, and Karimullah.

7. COMPARATIVE STUDY OF 'AMLA' PRODUCTS AND SYNTHETIC ANTIOXIDANTS FOR EDIBLE FATS (PART-I): In the present investigations 'Amla' (*Emblica officinalis*) products in comparison with synthetic antioxidants have been studied for retarding the onset of rancidity in ghee. The products investigated include the juice, sediment and residue of the fruit. The antioxidant properties of these substances have been compared with those of known antioxidants, such as propyl gallate L-tocopherol, butylated hydroxytoluene and lecithin, with and without citric acid.

Publication: Comparative Study of Amla Products and Synthetic Antioxidants for Edible Fats by Iftikhar Ahmad, M. K. Bhatty, Karimullah and Muhammad Akbar Saeed. Pakistan Journal of Scientific Research, 1960.

8. DETERMINATION OF NITROGEN IN ORGANIC COMPOUNDS WITHOUT DISTILLATION: (a) DETERMINATION OF AMMONIACAL NITROGEN IN ORGANIC COMPOUNDS: The distillation step in determination of ammoniacal nitrogen in organic compounds by Kjeldahl method has been eliminated. After having digested the sample in sulphuric acid with potassium and mercuric sulphates, the acid is neutralised. The resulting ammonium sulphate is treated with an excess of hypochlorite in presence of potassium bromide. An excess of arsenite is then added and back-titrated with hypochlorite using Bordeaux indicator.

Publication: Determination of Nitrogen in Organic Compounds Without distillation Part-I by Mohammad Ashraf,

M. K. Bhatty, and R. A. Shah. Pakistan Journal of Scientific and Industrial Research (1960).

(*b*) DETERMINATION OF NITROGEN IN NITRO, NITROSO AND AZO COMPOUNDS: A Kjeldahl method for the macro determination of nitrogen in nitro, nitroso, and azo compounds without resorting to the usual distillation step is described. These compounds are reduced with glucose to amino compounds which yield ammonium sulphate on digestion with sulphuric acid. The ammonium sulphate is determined titrimetrically by the hypochlorite oxidation method as described above.

Publication: Determination of Nitrogen in Nitro, Nitroso and Azo Compounds. Part—II by Mohammad Ashraf, M. K. Bhatty and R. A. Shah. Pakistan Journal of Scientific and Industrial Research (1960).

(*c*) ELIMINATION OF DISTILLATION STEP IN THE KJELDAHL METHOD FOR THE DETERMINATION OF NITROGEN IN AGRICULTURAL AND ANIMAL PRODUCTS: A method has been described for the determination of nitrogen in agricultural and animal products by a Kjeldahl method without distillation. The method involves digestion of the material with sulphuric acid and determination of the resultant ammonium sulphate by the hypochlorite-arsenite titration. The presence of iron in meat and blood does not interfere in the titration.

Publication: Elimination of Distillation Step in the Kjeldahl Method for the Determination of Nitrogen in Agricultural and Animal Products: by Mohammad Ashraf, M. K. Bhatty R.A. Shah. Pakistan Journal of Scientific Research (1960).

(*d*) ELIMINATION OF DISTILLATION IN THE KJELDAHL METHOD FOR THE MICRO AND SEMI-MICRO DETERMINATION OF NITROGEN IN NITRO, NITROSO AND AZO COMPOUNDS: Micro and semi-micro methods have been described for the determination of nitrogen in nitro, nitroso and azo compounds by a Kjeldahl method without distillation. It involves the reduction of a nitrogenous compound with either glucose or zinc in methanol and hydrochloric acid. The ammonium sulphate produced after the usual digestion either case is determined by the hypochlorite arsenite titration. A single vessel has been used for both digestions and titrations.

Project Associates: Mohammad Ashraf, M.K. Bhatty and R.A. Shah.

9. ESSENTIAL OILS FROM GRASSES, HERBS AND SEEDS: (*a*) KHAVI GRASS (*Cymbopogon iwarnscusa*) OIL: The Khavi grass is plentifully available in most of the arid parts of Pakistan. It grows wild in Bahawalpur Division, part of Sind, Baluchistan and the Thal area. The growth is fairly

extensive although exact quantities of the grass are not fully assessed. The grass contains about 2% of the oil. Besides the essential oil, the grass also contains a petroleum-ether extractable material to the extent of 1.5 to 2%, which is found to be an amorphous wax-like substance melting at 73°C. The substance is fragrant and almost white in colour. Its chemistry is being studied at present and the results will be reported later on.

It has been shown that the oil contains upto 60% of piperitone which can form the basis for the production of synthetic menthol.

(*b*). ARTEMISIA OIL: The santonin industry of Pakistan is suffering from a recession in view of stiff competition from synthetics. Because a sizeable part of the artemisia producing area of Pakistan was to some extent economically dependent on the profitable export of santonin, the artemisia collectors and growers are likely to suffer from this set-back. It is, therefore, important that some alternative outlet for artemisia be immediately found out. We are looking into this alternative by carrying out investigations on the essential oil of artemisia herb. The herb contains about 2% of the oil, which has been chemically analysed and found to contain over 60% of thujone along with a small amount of fenchone. Thujone can serve as the basis for an economic production of menthol-type materials.

(*c*). OTHER ESSENTIAL OILS: Systematic evaluation of the following materials was carried out with a view to establishing both quality and quantity of their oils:

Name of the materials	Percentage yield of oil
1. Juniper berries.	2.4
2. Ajowan	2.1
3. Caraway (black)	1.68
4. Caraway (White)	1.4
5. Fennel	1.3
6. Soya (dil)	1.1
7. Coriander	0.2
8. *Cymbopogon iwarnscusa*	1.38
9. *Lantana indica*	0.3
10. *Tulsi*	0.17-0.23
11. *Mentha piparata*	0.5
12. *Artemisia*	2.

It is indicated that a profitable industry, based on the production of various oils, can be set up in Pakistan.

(*d*) Turpentine Oil: According to a survey report on rosin and turpentine oil prepared by the department of Trade Promotion and Commercial Intelligence, Karachi, Pakistan produces annually over 100,000 cwts., of rosin and over 200,000 gallons of turpentine oil. The report estimates the present exportable surplus turpentine oil at about 85,000 gallons, which may rise to 350,000 gallons. It is thus evident that even with meagre forest resources Pakistan has still got a surplus of rosin and turpentine oil. Turpentine oil and rosin-based products which are mainly imported, thus received priority in our research programme. In this connection the development of processes for the production of turpene hydrate, terpeneol and synthetic pine oil is mentioned.

Unfortunately the turpentine oil that has come under our investigation does not contain more than 25% L-pinene, while for the economic production of camphor it has been reported (essential) that the oil must have more than 50% of L-pinene.

It is therefore suggested that high L-pinene containing varieties of pine should be grown in Pakistan. Besides, the cultivation of *Pinus paulstrid* (long leaf pine) should be undertaken for the production of pine oi- in the country.

(*i*) Production of Turpene hydrate and Terpeneol: These substances are of considerable commercial importance as they serve the purpose of cheap perfumes in cosmetics. Since at present they are all imported, attempts have, therefore, been made to prepare them here from turpentine oils.

Terpene hydrate and terpeneol have been prepared from turpentine oil. It has been found that by using suitable catalysts, the yields of these substances can be substantially raised. Laboratory-prepared samples have been subjected to factory trials.

(ii) Synthetic Pine Oil: Pine Oil is used for concentration of ores particularly sulphides in froth floatation cells. The oil is therefore, of particular importance to the metallurgical industry. Since natural pine oil is not available in the country, attempts were made to produce pine oil through hydroxylation of turpentine oil under suitable conditions. The oil produced is under evaluation and if it is found suitable, the problem will be taken up on pilot plant scale.

Project Associates: Mirza Nasir Ahmad, M. K. Bhatty and Karimullah.

10. Utilisation of Molasses: Large quantities of molasses, obtained as a by-product of the sugar industry in the country, are not being

effectively utilised. 50,000 tons of molasses were exported last year at very cheap rates.

Molasses contains upto 40% of sugar. If this sugar is recovered economically, not only can the country overcome its deficit in sugar, but also it enhances the worth of this waste. Our programme of work includes experiments for the recovery of sugar from molasses.

Successful experiments have been carried out for the utilisation of molasses as an effective source of sugar. One approach consists of the application of refining materials, ion exchangers and adsorbents, and the present results indicate that molasses is amenable to a considerable beneficiation. Futher work in this direction is in progress.

Project Associates: Nasir-ud-Din Zahid, Mehboob Elahi, M. K. Bhatty and Karimullah.

11. SYNTHETIC DETERGENTS: (*a*) PREPARATION OF TURKEY RED OIL FROM VEGETABLE OILS: The first phase of the programme, the production of Turkey Red Oil by cosulphonation from vegetable oils, is complete. A cosulphonation product of castor seed oil and cotton seed oil has been found quite promising and application for a patent on this process already been filed. Sulphonated oil prepared from cotton seed and other vegetable oils alone have now been prepared on the pilot plant scale. The products are being subjected to actual factory trials.

Project Associates; Shafiq Ahmad Khan, M. K. Bhatty, Karimullah and S. Siddiqui.

(*b*) SUGAR ESTERS: In advanced countries, several synthetic detergents are now being produced in large quantities for use in various industries. Sugar-based esters constitute a class of detergents which is playing an increasingly important role in synthetic detergent industry. Since many synthetic detergents are not amenable to micro biological break down, whereas sugar-based can be effectively eliminated in sewage treatment by bacteria, more emphasis is being laid on the production of the latter class.

Sacrose monoesters of higher fatty acids were prepared and tested on the laboratory scale. The monoester of abietic acid was also prepared. However, it has been found that its detergency is not of the same magnitude as that of the higher fatty acid esters.

Project Associates: Shafiq Ahmad Khan, Iftikhar Ahmad, M.K. Bhatty, Karimullah and S. Siddiqui.

12. PREPARATION OF ALCOHOL-BASED CHEMICALS: Ether and ethylene are the products obtained when alcohol is cracked at high temperatures. Since alcohol would be plentifully available within the country, attempts were made to prepare the above named chemicals by decomposing alcohol with various catalysts. A small scale cracking apparatus has been set up in the laboratory to complete the investigational side of the project.

A number of catalysts have been successfully tried for the cracking of alcohol. However, the best conditions have not so far been established which can give a maximum yield of ether in the first place. Investigations of different catalysts are being continued to yield either ether or ethylene in required quantities under pre-determined conditions.

Project Associates: Zahoor Ahmad, Naeem Shakar, M. K. Bhatty and Karimullah.

13. A STUDY OF INDIGENOUS CLAYS: INDIGENOUS BENTONTES FOR REFINING COTTON SEED OIL: A considerable quantity of indigenous bentonites is estimated to be available for various uses. Although a systematic survey of the production of bentonites has not yet been undertaken, a report about the bentonites of Bhimber and Chitti Deri of Azad Kashmir, Ganda, Rohtas, Jogi Tila Villages of District Jhelum and other areas in District Gujrat, has been brought out by the Geological Survey of Pakistann The report further states that bentonites are available in large quantity.

In Pakistan, no use has been made of these indigenous bentonites. In view of the large expansion of vanaspati (hydrogenated oil) factories there is a great scope for the utilisation of these bentonites for the bleaching of oil. At present, the demand is mainly met with the imported Fuller's earth, which considerably increases the cost of the process. Bentonites of local origin were therefore investigated with respect to their bleaching properties. Their performance, after activation, was compared with the imported Fuller's earth.

It has been found that although bentonites in their native form have no bleaching action and a simple heat treatment did not bring about an appreciable change in their bleaching properties, an acid treatment activated the clays very considerably. Heat treatment of the acid treated clays upto 350°C. further improved their bleaching properties. The optimum temperature for best activation was found to lie between 300-350°C.

Project Associates: Nasir-ud-Din Zahid, M. K. Bhatty, R. A. Shah and Karimullah.

14. Preparation of Soft Beverages: At present, commercial soft-drinks are becoming increasingly important; Coca Cola, particularly has achieved more or less a mass popularity. The materials for the production of these beverages are all imported at considerable expense in foreign exchange. It is, therefore, necessary that locally available materials be studied from the point of view of making soft beverages which come up to the standard of similar imported materials.

Sample soft beverages, having all the properties and characteristics of those based on imported material, have been prepared and tested in the laboratories. We have attempted to prepare these drinks from materials which are plentifully available. In this connection, the wastes from fruit and food industry have been extensively investigated.

Project Associates: Mohammad Ilyas, Farrukh Hassan Shah, M. K. Bhatty and Karimullah.

15. Evaluation of Tannin-bearing Plants of West Pakistan: In Pakistan there exists a flourishing tanning industry, but tanning materials required for this industry are in short supply and the only source which has been heavily relied upon is the 'Babul' Bark. This bark gives a tan which is highly coloured and hence, undesirable from the view point of making fancy leather goods. Besides, the quantity of tannins varies considerably in different varieties of Babul grown in Pakistan. Systematic investigations were therefore taken up with a view to examining possibilities of utilising tannin barks from other sources. Several trees of West Pakistan were studied in this connection and also to assess comparative tannin contents. Tannin contents of their barks, leaves, fruit, flowers, nuts and pods were determined, and it has been found that the Babul bark from Sind area contains the highest amount of tannins. Other trees such as 'Jund', 'Career', 'Ber' etc. and 'Dranik' shrub do not contain significant quantities of tannins.

Project Associates: Iftikhar Ahmad, M. K. Bhatty and Karimullah.

FOOD TECHNOLOGY AND NUTRITION

1. Liquid Glucose: Liquid and solid glucose is an important item, much needed for the confectionery, pharmaceutical and brewing industries. Although there is a factory at Peshawar which is manufacturing liquid glucose, at present it is mostly being imported. The factory, apparently is experiencing some difficulties in preparing material of the right type for liquid glucose. Upon a request from the factory, a process has been developed to prepare liquid glucose of the right quality on a laboratory scale. This study will

be soon extended to pilot plant scale, after which the factory would be visited and suitably advised.

Project Associates: Ehsan Ali, M. H. Hashmi and Karimullah.

2. Packaging Adhesives: The packaging industry uses appreciable amounts of adhesives for bonding paper and paper products. Adhesives for paper bonding are generally selected for low cost and for convenience in use on modern high speed production equipment. The substances which are most used as adhesives in our country are gelatin, animal glue, gum arabic, casein and starch. Gelatin, animal glue, casein and gum arabic give a poor type of adhesives which are not suitable for high speed production equipment due to their cost and quality. Moreover, labelling with these adhesives suffers from defects of putrefaction and bleeding from label edges. Further, labels become removable when kept in humid atmosphere and they crack under dry conditions.

The adhesives used in machine work are preferably kept thick or heavy in the glue pots but applied so that only a very thin film is transferred to form the joint. They should be tacky enough to produce a noticeable hissing on the machine, when it is running but should be so formulated that no webbing, spinning or fibring takes place as the rollers of the glue pad and the treated surface move apart.

As a result of systematic investigation, some starch-based adhesives have been formulated which are suitable for making card board boxes, envelopes, cigarette shells and for paper bag sealing. Applications for the grant of two patents on these adhesives have already been fired.

Patents: Pakistan Applications No. 266/60 and 268/60 dated April 4, 1960: "Manufacture of a starch based adhesive", "Manufacture of a Starch-based Adhesive for Use on High Speed Equipment" by Ehsan Ali, M. H. Hashmi and Karimullah.

3. Quantitative Aspects of the Base-catalysed Bromination of Acetaldehyde: Base-catalysed bromination of acetaldehyde has been studied with a view to using the method for the estimation of acetaldehyde in low conceutrations. The reaction is complicated by the formation of bromoacids and slow conversion of bromoform to carbon tetrabromide. The mechanism of the reaction leading to the formation of these abnormal products is also studied.

Publication; "Quantitative Aspects of the Base-catalysed Bromination of Acetaldehyde", by Muhammed Umar, Ehsan Ali and M.H. Hashmi, Pakistan J. Sci. Research, Vol. 12, 2, 1960.

4. IMPROVEMENTS IN THE MANUFACTURE OE KHANDSARI SUGAR: There is a great shortage of sugar in Pakistan, and the sugar produced by factories in East and West Pakistan is not sufficient to meet the demands of the growing population. Raw sugar prepared by village people in the form of 'Gur' and 'Shakkar' is of very poor quality. Due to inversion, its sucrose contents are also low.

In recent years there has been a tendency in villages to manufacture 'Khandsari' sugar. In this case again not only is the method wasteful due to low yield of Khandsari sugar, but there is also a foreign taste in the sugar due to the presence of certain chemicals used to decolourise the sugar cane juice. Moreover, the price structure of Khandsari, at the present time, is such as to place it outside the reach of the common man: Khandsari sugar is selling at about double the rate of the factory produced sugar. It was, therefore, considered desirable to undertake experiments to see whether a simpler method can be devised for clarification and decolourisation of the sugar juice, giving a better product in greater yield.

As a result of preliminary experiments, simpler and better methods have been developed for the clarification of cane juice, eliminating liming, sulphitation and carbonation processes. The yield of Khandsari sugar is after the separation of sugar is of better quality, and can be consumed directly as golden syrup because of the absence of chemicals which ordinarily give that off taste. Water soluble vitamins present in the sugar cane remain unchanged in the golden syrup and even the sugar. Further work is in progress.

Project Associates; Ehsan Ali, M. H. Hashmi and Karimullah.

5. PREPARATION OF PECTIN FROM CITRUS WASTES: Pectin is generally used for the preparation of jellies, marmalades, jams and fruit butters. It is not prepared in solid from anywhere in Pakistan. Since this form of pectin is most desirable, work was undertaken to prepare it from citrus wastes, guava and other allied fruits which are available in Pakistan in abundance. Results achieved so far indicate that the project can be extended to the pilot plant scale.

Project Associates: A. Rahim Sheikh, M. H. Hasmi and Karimullah.

5. MATERIALS FOR LITHO-PRINTING. Successful attempts have been made in these Laboratories to make roller composition of different grades

from locally available gelatine and glycerine. The products made are quite suitable for use in different climatic conditions. A patent has been filed for this work. Efforts are further being made to prepare litho-printing ink of good quality.

Patent : Application No. 267/60 dated 4th April, 1960: "A Process on Materials for Litho-printing", by Ehsan Ali, M. H. Hashmi and Karimullah.

BIOLOGICAL EVALUATION AND FERMENTATION

1. Establishment of a National Cultural Collection : Work has been started on the isolation of pure strains of bacteria, moulds and yeasts from different soils, fruits and other materials in Pakistan. It is proposed to maintain the pure strains in a national culture collection, after proper characterization. Some strains of yeasts, moulds and bacteria, which are of industrial or fundamental importance, have been purchased from abroad and are being maintained in the collection.

Project Associates : A. F. M. Ehtisham-ud-Din, Abdul Majid and Amir Mohammed.

2. Screening of Micro-organisms for new Antibiotics : The mould and bacterial strains locally isolated were screened for antibiotic activity using *Staphylococcus aureus*, *Escherchia coli* and *Aerobacter aerogenes* as test organisms. A number of strains have been found to inhibit the growth of some of these organisms on agar slants. The strains are now being grown in broth on a large scale with a view to isolating the antibiotic materials.

Project Associates : Amir Mohammed and Abdul Majid.

3. Production of Citric Acid : Citric acid is consumed in large quantities by the pharmaceutical industry for the production of calcium citrate and in beverages. Foreign exchange worth Rs. 3,50,000/- is annually spent for the import of this material. Different strains of *Aspergillus niger* were studied to select the one giving the maximum yield of citric acid. Conditions for maximum production of citric acid from molasses were then worked out on a pilot plant scale.

There was no satisfactory colorimetric method available for the estimation of citric acid, and efforts are therefore being made to develop a sensitive and accurate method for this estimation.

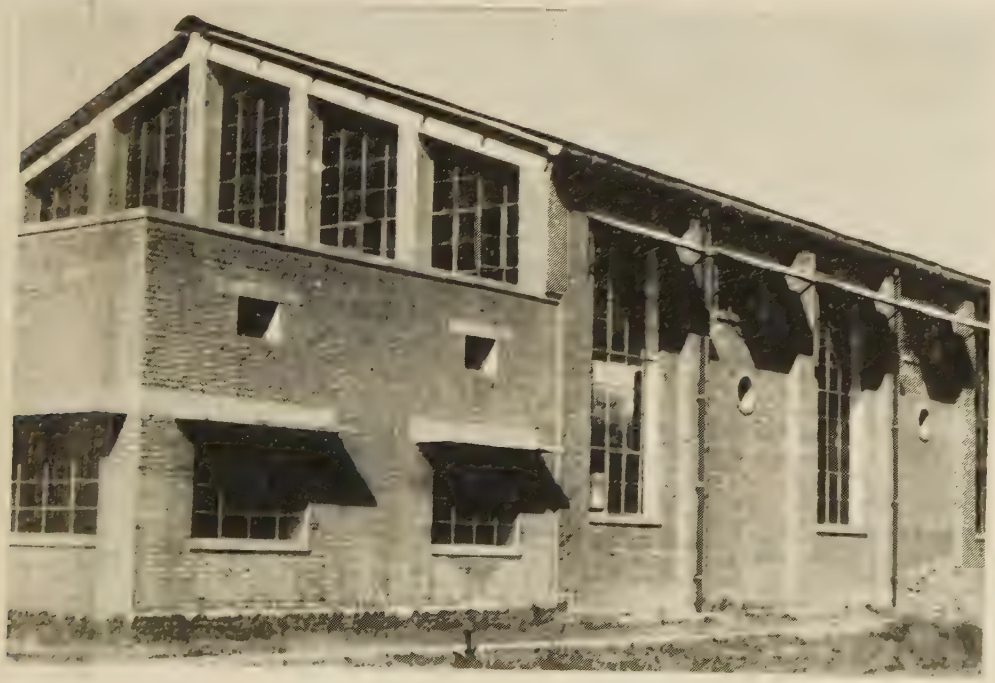
Project Associates: M.A. Wahid, Nawazish Ali, and Amir Mohammed.

The President of Pakistan and Mr. Akhtar Husain, Governor, West Pakistan in Food Technology Division during their visit to West Regional Laboratories.

The Duke of Edinburgh is being shown the Food Technology Division by Dr. Karimullah, Director, West Regional Laboratories.

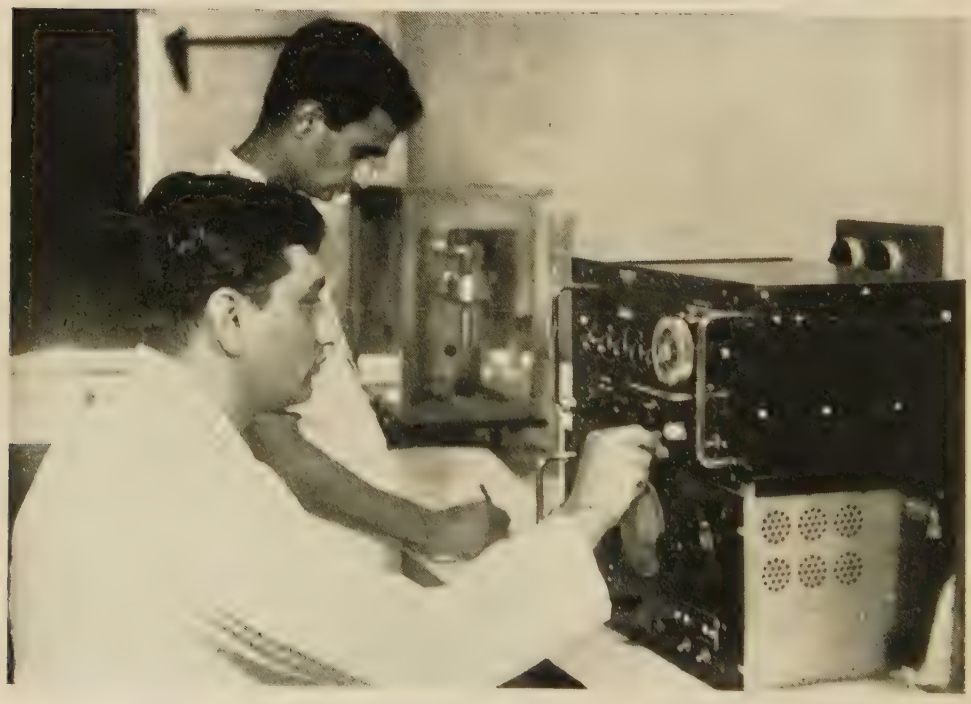
Some Products of the Glass and Ceramics Division, West Regional Laboratories.

Oils, Fats and Waxes Division, West Regional Laboratories.



Workshop Building, West Regional Laboratories.

Front view of Food Technology Building, West Regional Laboratories.



Biological Evaluation & Fermentation Division, West Regional Laboratories.

4. PRODUCTION OF YEAST: A variety of yeast, *Torula utilis*, is being extensively used both as animal and a human food. The reasons for its increased production and utilization as food are that (*i*) it contains a large percentage of protein which is well absorbed and utilized in the body, and (*ii*) it serves as a good source of B group vitamins. Other varieties of yeast find their use in the baking and brewing industry. All the yeasts which our bakery and brewery use are, at present, imported at the cost of our valuable foreign exchange.

The prospects of yeast production in our country are bright. We have sugar factories from where molasses are thrown away as waste, and the same applies to the waste liquor of fruit canning industries. These wastes may be utilized as raw material for producing yeast.

A successful attempt has been made for producing baker's yeast from waste molasses. The yeast strains isolated locally compared well with a foreign baker yeast and grew satisfactorily on molasses, yielding about 25% of dried yeast on molasses basis.

Publication: "Production of Yeast on Large Scale" by Ehtisham-ud-Din, Mohammad Saeed and Karimullah. Pakistan J. Sci. Research No. 4, 1960.

5. PRODUCTION OF L-GLUTAMIC ACID: Work has been carried out for the production of l-glutamic acid and monosodium glutamate which finds use as a meat flavouring agent. A number of strains collected in our laboratory, are being tried for their ability to produce glutamic acid. The enzymic synthesis of l-glutamic acid from citric acid and ammonium salts is also under investigation.

Project Associates: Fayyaz-ud-Din, Amir Muhammed and Karimullah.

6. VINEGAR MANUFACTURE: Vinegar is used for making pickles as such, as a condiment and as a source of acetic acid. Although there are extensive possibilities for the production of this commodity in the country, no serious efforts have been made so far for its large-scale preparation.

A specially designed acetator has been prepared in this laboratory for the production of vinegar, in which the time for the production of vinegar has been shortened. Efforts have been made to get better quality of vinegar, which may be used for the manufacture of white vinegar. Molasses and fruit wastes have been used for the production of vinegar by fermentation.

Project Associates: M. A. Wahid and Amir Muhammed.

7. Enzymology of Polymetaphosphate in Micro-organism: Polymetaphosphate (PMP) is a high molecular weight inorganic polymetaphosphate which occurs exclusively in micro-organisms. The enzyme catalysing the synthesis of PMP form adenosine triphosphate has been partially purified from yeast and its mechanism of action has been investigated.

Research Worker: Amir Muhammed.

8. Chemistry and Biochemistry of Yeast Pigments: A few pigmented yeast strains locally isolated were grown on large scale in order to study the chemical nature and biochemical role of their pigments. Two pure crystalline pigments have been isolated and their chemistry is being studied. Elementary analysis has shown the presence of Fe, C, N, O and S in one of these compounds. Further work is being done in order to establish the structure of these substances and their metabolic role in the cells.

Project Associates : G.A. Shaukat, Ifzal Ahmad, Amir Muhammed and Karimullah.

9. Studies in the Mechanism of Action of Antibiotics: Locally collected pigmented strains of bacteria and yeast were grown in presence of penicillin. The pigment formation in a yellow coloured organism was completely inhibited by penicillin, although, the antibiotic did not affect the growth. Further work is being done on the isolation and characterization of the pigment and the enzyme system responsible for pigment synthesis. This will help in the elucidation of mechanism of action of penicillin in stopping the growth of susceptible organisms, about which little is so far known.

Project Associates: Amir Muhammed and Tanvir-ul-Hasan.

10. Gluconic Acid Production by Fermentation: Gluconic acid is used extensively in the form of its calcium salt as a source of readily available energy for invalids and patients. Calcium gluconate is being imported in large quantities from abroad, at the cost of valuable foreign exchange. The production of gluconic acid from glucose, using strains of *Aspergillus niger* and *Penicillium chrysogenum* has been started on a laboratory scale. The growth and fermentation media and other conditions for this process have been worked out and the process is to be tried on pilot-plant scale.

Project Associates: Amir Muhammed and Hamid Masood Javed.

11. STUDY OF SOIL MICRO-ORGANISMS: The study of soil micro-orga-nism has excited great interest in many countries, because of their influence upon soil fertility and hence upon crop yield. But in our country very few workers have undertaken the study of this branch of mycology. Another important aspect of the soil microbes is that they inhibit the growth of or even kill certain plant pathogens present in the soil by producing certain toxic substances. On this basis some of these strains are being tested for their industrial value in the form of their metabolic products.

The present work of screening the *Kalar* and ordinary soil has been undertaken to show the presence and absence and the nature of micro-organisms in the soil.

Research Worker: S. R. H. Rizvi.

12. STUDY OF WATER-MELON RUST—*Puccinia citrulli*-SYD AND BUTLER: This pathogenic rust was first reported by Butler from Coimbatore, Madras on *colocynthis* plants and later in 1949 on water-melon at Karachi. This rust on the later host is restricted to Karachi. During the studies it seems that the two are specifically identical, but the behaviour shows that it is a different variety and is named as *Puccinia citrulli var. vulgari* The infection is seen only during April to June. With a view to checking the disease, studies on the life history, collateral host and perennation of the rust have been taken in hand. The fungus causes considerable destruction every year.

Research Worker: S. R. H. Rizvi.

13. PHYSIOLOGICAL STUDIES OF *Curvularia* SP. AND *Empusa* SP: The physiological studies of these moulds have been undertaken to see effect of temperature, incubation period and changes in media constituents for increasing yield of the metabolic products.

Research Worker: S. R. H. Rizvi.

14. METABOLIC PRODUCTS OF MOULDS: (*a*) ISOLATION OF METABOLIC PRODUCTS OF *Curvularia* SPECIES: *Curvularia siddiqui*, a new mould was grown in one-litre conical flasks on a synthetic medium containing glucose as the carbon source. The flasks were incubated at 26—28°C.for 20—22 days. The metabolic solution was then repeatedly extracted with ethyl-acetate. On recovery the extract gave a coloured semi-solid mass which was seperated into acidic and non-acidic fractions. The non-acid fraction crystallises on

keeping (m.p. 136°C.); when recrystallised from water gave light yellow prismatic needles (m.p. 145°C.)—named Curvulin.

The acid fraction on crystallisation from ethyl acetate gave two types of crystals which were separated mechanically. The larger crystals in clusters, recrystallised from ethyl acetate in microscopic needles (m.p. 154°C.)—named curvulic acid, the smaller ones recrystallised from water (m.p. 218°C.) named curvulinic acid.

Curvulin which is active against *staphylococcus* and *Eschrichia coli* is soluble in acetone, dioxane, ethyl acetate, ethyl alcohol, and methyl alcohol, sparingly soluble in ether, benzene chloroform, water and acetic acid, insoluble in carbon tetrachloride and petroleum ether.

Neither curvulin nor curvulinic acid show any optical rotation.

Project Associates: Nisar Ahmad, Mazhar Ali Khan and Ahmad Kamal.

(*b*) CONSTITUTION OF CURVULIN AND CURVULINIC ACID ISOLATION FROM CURVULARIA SIDDIQUI: Analyses of curvulin indicate the presence of two C-CH_3 one O-CH_3 (or one O-C_2H_5).

The following curvulin derivatives were prepared:

(*a*) Two mono-methyl derivatives by reaction with dimethyl sulphate (m.p. 165°C. and m.p. 114°C.)

(*b*) Two mono-methyl and one dimethyl derivatives by reactions with diazo-methane (m.p. 84°C.) (m.p.204°C. and a liquid)

(*c*) Acetyl derivative (m.p. 120°C.)

(*d*) 3:5—dinitro-benzoyl derivative (m.p. 146°C.)

The analyses of all these derivatives confirm the molecular formula: C_{12} $H_{14}O_5$ for curvulin.

Curvulin is reduced by sodium borohydride to give a compound $C_{10}H_{12}O_4$ (m.p. 204°C.)

It gives an addition compound with diazo amino benzene (m.p.22°C.), which indicates the presence of at least two hydrogen atoms directly attached

to benzene ring. The benzene ring is indicated by the u.v. spectra (270 mμ and 320 mμ). Phenolic nature of the two oxygen atoms is indicated by ferric chloride colour reaction as also by the reactions of diazomethane and dimethyl sulphate. Methylated curvulin on alkaline potassium permanganate oxidation gives an acid (m.p. 216°C.) which is under investigation.

Curvulinic acid, molecular formula $C_{10}H_{10}0_5$, has been established as hydrolysed curvulin.

Project Associates: Mazhar Ali Khan, Izhar Hussain Qureshi and Ahmad Kamal.

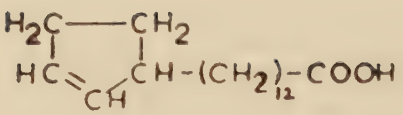
15.—Isolation and the Constitution of the Sterol Present in *Cassia absus* Linn: It was noted that *Cassia absus* Linn. seeds were used as an aphrodisiac in the Punjab. The study of the unsaponifiable fraction was, therefore, undertaken. The oil of *Cassia absus* Linn. was saponified with 10% alcoholic potassium hydroxide and extracted with ether. Extracts on recovery of ether gave a coloured crystalline solid, which was recrystallised from aqueous alcohol (m. p. 138°); $[\alpha]_D^{29°C} = -38.5°$. Attempted fractionation of this solid by column chromatography and through the preparation of the digitinoid always gave the same product. A solution in chloroform decolorises bromine and also aquous potassium permanganate solution.

Infra red spectrum in nujol gave peaks at 3400 cm^{-1} (indicating OH); 1640 cm^{-1} (indicating —C=C—double bond); 1590 cm^{-1} (indicating conjugated —C=C—); 1026 cm^{-1}.

The molecular formula $C_{29}H_{50}0$ assigned to it also agreed with the analyses of mono-acetyl derivative (m. p. 129°C. $[\alpha]_D^{29°} = -50.5$) and mono-benzoate derivative (m. p. 141°C.) The sterol was indetified as B-sitosterol.

Project Associates: Mazhar Ali Khan and Ahmad Kamal.

16. Synthesis of Pharmacologically Active Compounds from Bhilawanol: The use of Chaulmoogra oil as a specific for the treatment



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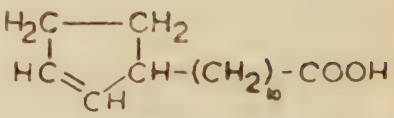

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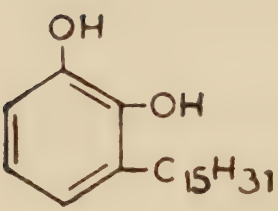

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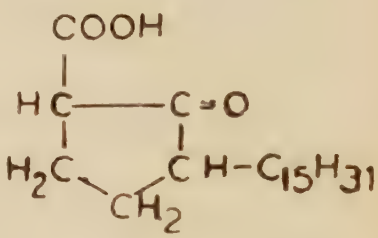


IV

of leprosy originated many centuries ago with the Chinese. Subsequently it has been conclusively proved that the cyclic acids (viz. Chaulmoogric acid (I) and Hydnocarpic Acid (II) present in chaulmoogra oil are responsible for these curative properties. These investigations marked a new era for synthesising closely related cyclic acids, with a view to correlating bactericidal activity with chemical structure.

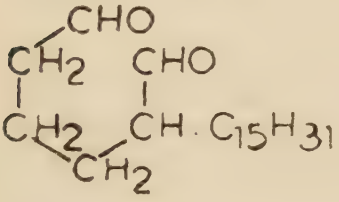
The present work aimed at synthesising 2 pentadecyl-5 carboxy-cyclopentan-1-one (IV) from Bhilawanol (III) with the view to studying its pharmacological properties and for its possible use in the treatment of leprosy. Theoretical considerations based on the presence of a long side chain attached to the benzene nucleus in Bhilawanol (III) made this study of particular significance with reference to the therapeutic properties and structure of chaulmoogric acid (I) and hydnocarpic Acid. (II).

Bhilawanol (III), the main constituent of the juice of *Semecarpus anacardium*, Linn. (Bhilawan, Dhobi's Marking Nut) was methylated, in two steps, to obtain Bhilawanol di-methyl ether, which, on catalytic reduction (palladium on charcoal) gave hydro-Bhilawanol di-methyl ether. Ozonization of this product in chloroform gave di-methyl, 1-pentadecyl muconate, which was purified through its acid. Hydrogenation of this acid gave 1-pentadecyl adipic acid. The ethyl ester of this acid, when subjected to high-vacuum distillation, yielded a cyclised product, 2-pentadecyl-5 carbethoxy-cyclopentan-1, which, on hydrolysis yielded 2-pentadecyl-5 carboxy-cyclypentan-1-one (IV).

The above synthesis, however, had certain drawbacks both from the practical point of view and theoretical considerations, an alternate synthesis

of the 1-Pentadecyl adipic acid (VI) as the important intermediate for the synthesis of 2-Pentadecyl-5-carboxy-cyclopentan-1-one (IV), was carried out. Bhilawanol was hydrogenated under high pressure and elevated temperature with Raney Nickel as catalyst in absolute alcohol. This resulted in the hydrogenation not only of the side chain but also of the benzene ring giving a mixture of *cis* and *trans* isomers of 1-Pentadecyl cyclohexan-2-;3-diol. These two were separated by fractional crystallisation from acetone giving the *cis* diol (m. p. 56°CO and *trans* diol (m. p. 78°). Their *cis* and *trans* configurations were further confirmed through periodate oxidation rates.

Both isomers on oxidation with lead tetra acetate gave the same aldehyde: l-pentadecyladipaldehyde (m. p. 78°) (V) which was oxidized to



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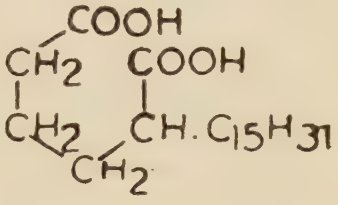

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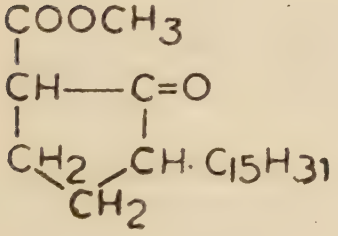

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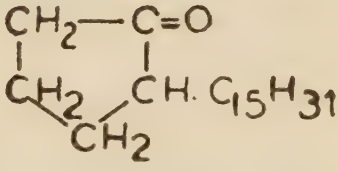


VIII

he corresponding adipic acid (m. p. 86°C.) (VI) with silver oxide.

Further investigations to successfully carry out Dieckmann Cyclization of the dimethyl ester to obtain 2-Pentadecyl-5-carbmethoxy cyclopentan i-one (VII) are in progress. Attempts are also being made to obtain 2-Pentadecyl Cyclopentanone (VIII) through the distillation of the barium salt of l-Pentadecyl adipic acid.

Project Associates: Abdul Majid Hamid, A. Kamal and Izhar Hussain Qureshi,

17. A METHOD OF DRYING ANIMAL BLOOD: Among the slaughter house waste materials, blood is of great commercial value. Pakistan produces annually about 25000 tons of animal blood, which, if properly dried and exported, can bri.g nearly 25 lakhs of rupees in foreign exchange. A simple process has been evolved in these laboratories to prepare a dried product from blood suitable as a fertilizer and an animal feed. The process has been tested successfully on pilot plant scale and has recently been leased out to Messrs Sabi & Co., for commercial utilization. Dried blood is especially useful for fruit crops, and is also an excellent and cheap source of high quality proteins for poultry.

Patent: Pakistan Application No. 269/60 dated April 4, 1960, "A Method of Drying Animal Blood", by Mohammad Saeed and Karimullah.

18. A PROCESS FOR THE PRODUCTION OF A WATER-RESISTANT GLUE FROM ANIMAL BLOOD: The locally manufactured adhesives used at present by the plywood industry in Pakistan are of very poor quality. A water resistant glue which has been tested successfully by various industrial concerns has been made in the laboratory from animal blood. The process involved in making this glue can be used economically on a commercial scale, and the use of blood glue for plywood manufacture will improve the quality of plywood considerably while making it cheaper.

Patent: Pakistan Application No. 270/60 dated April 4, 1960, "A Process for the Production of Water-Resistant Glue from Animal Blood", by Mohammad Saeed and Karimullah.

19. BONE GELATINE AND BONE PHOSPHATE: Several useful products of great economic importance can be made from bones, e.g. bone gelatine, bone powder and bone phosphate. The processes commonly employed to obtain gelatine from bones are time-consuming and involve the use of heavy chemicals. A direct process is therefore, preferable to make the product economical.

The process developed in this laboratory is very rapid and involves small amount of various readily available locally produced chemicals. The product obtained contains 80 per cent gelatine and gels very easily even in dilute solution. After gelatine has been extracted completely, the residual bone powder is dried and ground to 80 mesh. This material represent a source of readily available phosphorous and calcium.

Project Associates: Mohammad Saeed, Mohammad Sadiq and Karimullah.

20. PRODUCTION OF GOSSYPOL-FREE PROTEIN CONCENTRATE FROM COTTONSEED CAKES: At present the local use of cottonseed cakes is limited only to animal feeds, while considerable portion is exported. The need for finding new sources of edible protein is obvious in our country. Laboratory experiments on the preparation of edible cottonseed flour, rich in proteins and free from golssypol have been fairly successful. The products are odourless, tasteless and have a pleasant cream colour. The nutritional aspects of various such flours have been successfully investigated on laboratory animals. Their production on the pilot plant scale is to be taken up. An application for the patent coverage is filed.

Project Associates: Mohammad Saeed and Karimullah.

21. PROTEINS OF *Asphodelus Fistulosus* (PIAZI) AND THEIR AMINO ACID MAKE UP: *Asphodelus fistulosus* (piazi) weed grows along with the wheat crop. It is not used for any purpose and it, therefore, goes waste. In addition to oil and carbohydrates, it contains about 16% proteins, but no information is available on the nature of its protein and their amino acid make up.

Experiments on the preparation of edible protein flour from piazi seeds have been finalised. The flour is colourless, odourless and contains 50% proteins. Complete amino acid analysis of the protein has been carried out to evaluate the nutritional significance of the proteins. The work is ready for publication.

Project Associates: Mohammad Saeed, Mohammad Afzal Malik and Karimullah.

22. GUWAR SEED FLOUR: Guwar is much used in India, Pakistan, Indonesia and other Eastern countries as a fodder and green manure. Due to the presence of a bitter taste and an odour in it, the seed is not fit for human consumption. Guwar seed when ground under special conditions yields a flour which has protein contents as high as 55 per cent.

A very simple process has been evolved, by the use of which a flour, free from odour and bitterness, has been prepared. The flour has a colour similar to that of whole wheat-flour and has over 50 per cent protein which is superior to wheat protein. The process has been shown to be commercially feasible, and it is suggested that production of such flour may be taken up by the Government on a commercial scale to help meet the shortage of high quality proteins in our food-stuffs.

The protein of Guwar seeds is fairly comparable to casein and meat regarding its amino acid contents. Experiments on animals to assess the availability of protein for growth have also been conducted.

Project Associates: Mohammad Saeed, Mohammad Afzal Malik and Karimullah.

23. Proteins from Vegetables and Grasses: Some proteins are always present in almost all plants that are eaten by man or animal. Investigations on laboratory scale extraction of a proteinous material from vegetables with a view to fortifying our normal food (bread, chapaties, rice, milk etc.) have yielded encouraging results. Pilot Plant experiments are in progress.

Project Associates: Mohammad Saeed and Karimullah.

24. Chemical investigations of 'mazri' leaves: 'Mazri' leaves, which grow wild in abundance in Pakistan, find at present limited use only for the making of mattings and hand fans. The surplus is wasted or burnt. Attempts have therefore been made to extract a useful compound from the dried leaves with hot alcohol. This waxy compound is colourless and melts at 80°C. It is insoluble in both hot and cold water and is difficultly soluble in cold organic solvents. It however, goes into solution with alcohol and petroleum-ether when heated. Further investigations on its properties are in progress.

Project Associates: A. R. Sheikh, Mohammad Saeed and Karimullah

GLASS AND CERAMIC

1. Evaluation and processing of Glass-making Sands: About forty samples of glass-making sands were collected from different regions of West Pakistan and were put through various physical, chemical and microscopical tests. From the results obtained, it was concluded that, although many of the sands were not fit for glass making, they can nevertheless be made useful if proper efforts are expended for that purpose. With this view, work on the beneficiation of sands was undertaken, and of the comparative analytical data of various treated and untreated sands is being studied.

Project Associates: Ghulam Rasul and F. A. Faruqi.

2. Preparation of Low-firing Earthenware Bodies: As is well known, Pakistani ceramic-wares are generally inferior to the imported ones. The usual reason given for this defeciency is the nonavailability of better

raw materials. A thorough investigation of the indigenous raw materials, however, reveals the incorrectness of this view. In the light of the evaluations undertaken by our Analytical Section, it was established that better bodies and glazes *can* be developed if due attention and care are given. About a dozen successful bodies, with low to medium vitrifying temperatures were produced. These bodies consist of clay-silica, clay-feldspar, clay-silica-feldspar, clay-silica-talc-feldspar and clay-cullet systems; they can be used with advantage for the manufacture of tiles, white-wares etc.

Project Associates: Masud Ahmad Beg and F. A. Faruqi.

3. PREPARATION OF LOW TEMPERATURE GLAZES: Two of the chief defects associated with Pakistani glazes are crazing and yellowishness (or pinkishness). Especial emphasis was therefore, laid on the removal of both these defects. Dozens of various types of glazes viz., lead, leadless, boro-silicate, lead-boro-silicate, zinc, zincless, etc., were prepared and tried upon the various successful bodies. The experiments cover "SEMI-PORCELAIN GLAZES" and "THE CAUSE AND CURE OF CRAZING". Therefrom Various patentable recipes were formulated.

Project Associates: Azizul Haq and F. A. Faruqi.

4. PERMEABILITY AND THERMAL CONDUCTIVITY OF VARIOUS FIRE AND INSULATING BRICKS: For researches in the field of refractories, a knowledge of such properties as permeability and thermal conductivity is of utmost importance: it helps in the proper evaluation and further improvement of the products. Pieces of apparatus for the measurement of the same were, therefore, designed and fabricated in the Laboratories. The permeability and thermal conductivity of various country-made fire and insulating bricks were measured and their comparative usefulness was determined.

Project Associates: Mohammad Ibrahim and F. A. Faruqi.

5. CHROME MAGNESITE REFRACTORIES: Many problems regarding installation of the two proposed steel plants are anticipated; among them a major problem will concern refractories, because millions of chrome-magnesite bricks will be required marely for repairs and replacements, not to mention those thousands of millions that would be required for the initial lining. Sooner or later, indigenous production of high grade refractories will be a *must*, and to that end a great effort should, therefore, be expended right now. Bearing in mind the abundantly available low grade chrome ore (which is being dealt with merely by dumping), work on the production of chromite-magnesite bricks was started. Preliminary investigations are nearly complete and the results obtained are satisfactory.

Project Associates: Mohammad Ibrahim and F. A. Faruqi.

6. Furnace designing and construction: Experiments related to design of furnaces, their efficiency, fuel economy etc., have been undertaken. The following five oil-fired furnaces have been designed and constructed:-

(*a*) A pot furnace to make frits etc. This furnace can contain crucibles upto $6\frac{1}{2} \times 4\frac{1}{2}$ inches.

(*b*) A small muffle furnace for glass firing. Its capacity is 1/3 cu. ft., and the safe temperature maximum is 1250°C.

(*c*) A down-draught round kiln for biscuit firing. Its capacity is 4 cu. ft. and the safe working temperature found out to be 1300°C.

(*d*) A down-draught brick kiln, (the chimney of this kiln is under construction). Its capacity is 15 cu. ft.

(*e*) A rectangular updraught, steel encased furnace. The framework is of foreign make, but the inside lining was prepared in the Laboratories. It is fitted with three burners. Its capacity is 6 cu. ft. This furnace gives an appreciably steeper time-temperature curve. A maximum temperature of 1450°C. can be achieved with this furnace; the lining however, cannot withstand such a high temperature. Its safe working range is 1325°C.

Apart from these furnaces, a small recuperative type of tank furnace has also been designed and is under construction.

Project Associates: Latif Hussain Ata and F. A. Faruqi.

PHYSICS SECTION

1. Design of Pistol Soldering Iron: Soldering irons commonly available in the market take a long time to heat, and have to be kept switched "on" continuously. Work has, therefore, been taken up on the design and construction of the pistol-type soldering iron, which heats up almost instantaneously, thereby saving power and time. A design meeting the above described requirements has been successfully tested. It posseses some patentable features.

Project Associates: M. H. Osmani and A. Rauf Anwar.

2. MANUFACTURE OF PAPER CONDENSERS: Condensers are the essential components of all electronic circuits, but they are not easily available in the market. In continuation of previous work in the Central Laboratories, Karachi, this problem was started in order to utilise indigenous materials in the preparation of the component. Data on working voltage, life, etc. have been collected and it has been shown that the manufacture of paper condensers is feasible.

Project Associate: M. H. Osmani.

3. DESIGN OF LOW POWER TRANSISTORISED D.C. TO A.C. CONVERTER: The conventional methods, hitherto, used for converting D. C. to A. C. are by means of rotary converters or vibrators. This has an intrinsic drawback that the moving parts wear out very soon. Transistors have been employed for this purpose, because they do not involve any moving parts. This results in a considerable reduction of the size of the gadget also.

Project Associates: M. H. Osmani and Abdul Waheed.

4. PREPARATION OF BROMIDE PHOTOGRAPHIC PAPER: Bromide paper is very extensively used in photography. Since all the paper is presently imported at the expense of considerable foreign exchange, work was started with a view to formulating an emulsion for the manufacture of the paper. This has been successfully achieved on the laboratory scale.

Project Associates: Late M. Ishaq and A. Rauf Anwar.

5. INSTRUMENT CUM ELECTRONIC SECTION: An instrument cum electronic section with a well equipped workshop has been established for servicing physical and electronic instruments. Routine physical/chemical estimations involving spectrophotometers, microscopes, pH meters etc. are also being undertaken. The establishment of this scetion will, it is hoped, provide a valuable service for the whole laboratories.

Project Associates: M. H. Osmani, A. Waheed, and A. Rauf Anwar.

6. SHRINKAGE FACTOR OF NUCLEAR EMULSION PLATES EXPOSED TO 6 BeV. PROTON BEAM: The basis of the measurement is to locate the π meson μ meson electron events and to measure the range of the μ mesons. From the statistical analysis of the range measurements, it is Possible to find out the shrinkage factor of the emulsion after exposure. One hundred events were located and their range measured with a binocular

microscope. The values of shrinkage factor thus obtained are within the range of experimental error.

Project Associates: K. Ilahie and D. C. Wold.

7. Design of Solar Water Heater, Still and Cooker: A solar water heater has been designed and the relevant data are being collected in order to calculate the probable efficiency for such a device at Lahore. Two solar stills with different constructional details were fabricated. The purpose of the experiment was to compare the yield per square foot of the base area of the two stills. The daily yield of the still during the summer months was between 0.8-1 lb. per square foot approximately. During the winter month, it was half of this. It has also been observed that the performance of the stills with insulated base is a little better than that with concrete base. Further data are being collected.

An absorption type solar oven of cooker has also been designed, which can give a maximum temperature of 145°C.

Project Associates: Late Lt. Col. Dr. M. Ishaq, Karam Ilahie, Karimullah and Ehsan Ullah Khan.

8. The Effect of Temperature on Surface Tension of Salts present in Saline Soils: This effect was studied up to 60°C. using sodium sulphate, sodium chloride, sodium nitrate and sodium carbonate. The measurements of the surface tension of these salts in solutions show the expected decreases with the increase of temperature.

Project Associates: Late Lt. Col. Dr. M. Ishaq, M. H. Osmani and Ehsan Ullah Khan.

NORTH REGIONAL LABORATORIES

INDIGENOUS DRUGS RESEARCH

1. STUDIES ON *Hyoscyamus Niger:* Commonly known as "Henebane", it is one of the important drugs used in the pharmaceutical industry. The plant is being successfully cultivated in many parts of India and Kashmir. Unfortunately, no attempt has yet been made to carry out its cultivation from the commercial point of view in the areas now comprising West Pakistan. Because the climatic conditions in Peshawar are quite different from those of the places where *Hyoscyamus* has already been grown successfully, it was considered desirable to conduct some investigations on this useful plant.

Analysis on the chemical contents of wild *Hyoscyamus* collected from different localities was made and experiments on its cultivation were undertaken on a small scale at the experimental farm of these Laboratories. Detailed observations on the methods of its cultivation, collection, drying and storage have been recorded. The possibilities of its commercial cultivation in this region are under further investigation.

Publication: "*Hyoscyamus Niger:*—its Cultivation and Commerce" by M. A. Kazmi, Pakistan J. Sci. Research, Vol. 12, No. 1, Jan. 1960.

2. *Digitalis Purpurea:* A very important drug, it is in great demand in Pakistan. Its leaves and preparations which are imported from abroad are found to lose their activity from 25 to 40 per cent during transportation. While India has already become self-sufficient in this drug, no systematic attempt at its cultivation has been made so far in Pakistan. From the experiments carried out on the cultivation of *Digitalis purpurea* in the experimental farm of the North Regional Laboratories, it is observed that the digitalis crop if grown on a large scale in open fields are unable to stand the high temperature during the monsoons. The plants can, however, survive during these months if they are protected from hot environment. The most suitable plant which could be to provide shade and thus protect the plants was found to be *Datura fastuosa* planted in alternate rows. The yield per acre of the dried leaves has been quite promising from the economic standpoint. Cultivation can therefore be undertaken on a large scale in the North Western regions of West Pakistan and in Azad Kashmir to meet the growing requirements of the pharmaceutical industry of Pakistan.

Biological standardization of the local leaves was undertaken on Guinea pigs to compare it with the international standard Digitalis powder. It was found that 82.6 mgms. of the local leaves have the potency equivalent to 76.9 mgms. of the standard powder and hence contain one international unit of Digitalis activity.

Publication: "Cultivation of *Digitalis purpurea* at Peshawar" by M. A. Kazmi, Pakistan J. Sci. Research, Vol. 12, No. 3,1960.

3. Pharmacology of Chaksine Chloride: Chaksoo, the seed of *Cassia absus* Linn. is used by indigenous practitioners for various eye ailments. Chaksine chloride, the purified alkaloid from chaksoo has been investigated pharmacologically, and it was found that when given subcutaneously in mice and rats in sub-lethal doses, chaksine chloride causes pupillary dilation. However, local application in the eye fails to produce this effect even in very high concentrations.

It was also found that chaksine chloride has a strong local anaesthetic action when given by infiltration. Its potency was compared with that of cocaine through intradermal wheal method; and it was found to be about as effective as the latter. The LD_{50} in mice is 95.6 mg/kg body weight administered subcutaneously. Chaksine chloride has a strong acetyl choline blocking action in isolated frog rectus preparation. Further studies are in progress.

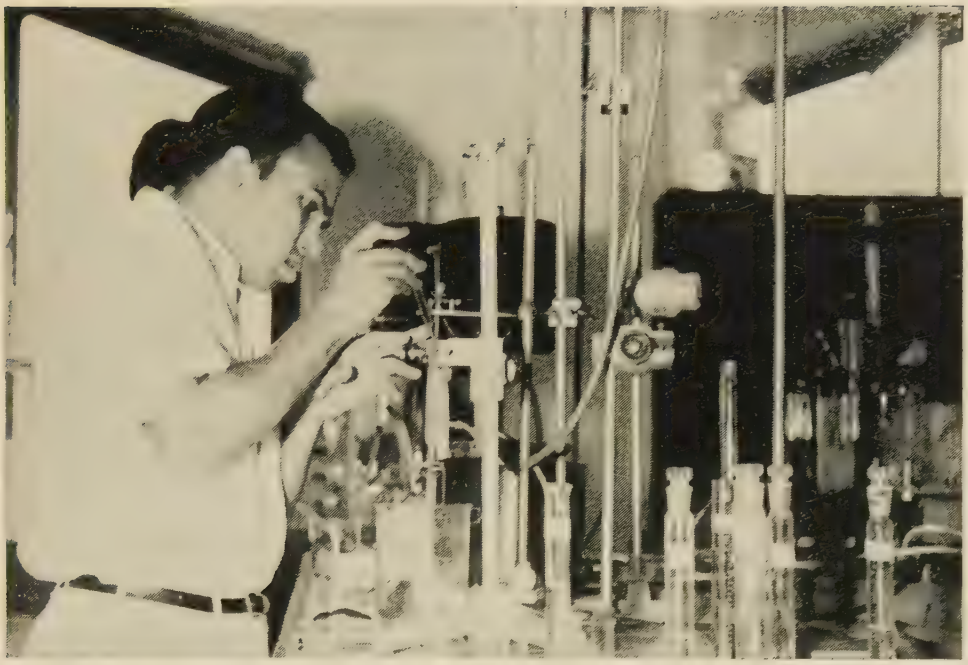
Project Associates: H. K. M. Abdul Hye and M. A. Wahid.

4. *Crysanthemum cinerariaefolium:* The plant belongs to *Compositae* family. Its flowers contain Pyrethrin I and Pyrethrin II and have insecticidal properties. It generally grows at a height of above 4,000 ft., and studies were undertaken in our experimental farm to see how far it can be grown successfully in the plains. A yield of 70 lbs. per acre of flower was obtained. Different chemical methods were used to estimate the content of Pyrethrin I and Pyrethrin II in the flowers.

The total Pyrethrins content ranged from 1.06 to 1.3 per cent. which compares well with the I. P. C. Standard i. e. 0.4 to 2 per cent. Further work is in progress to estimate its percentage in the fresh material.

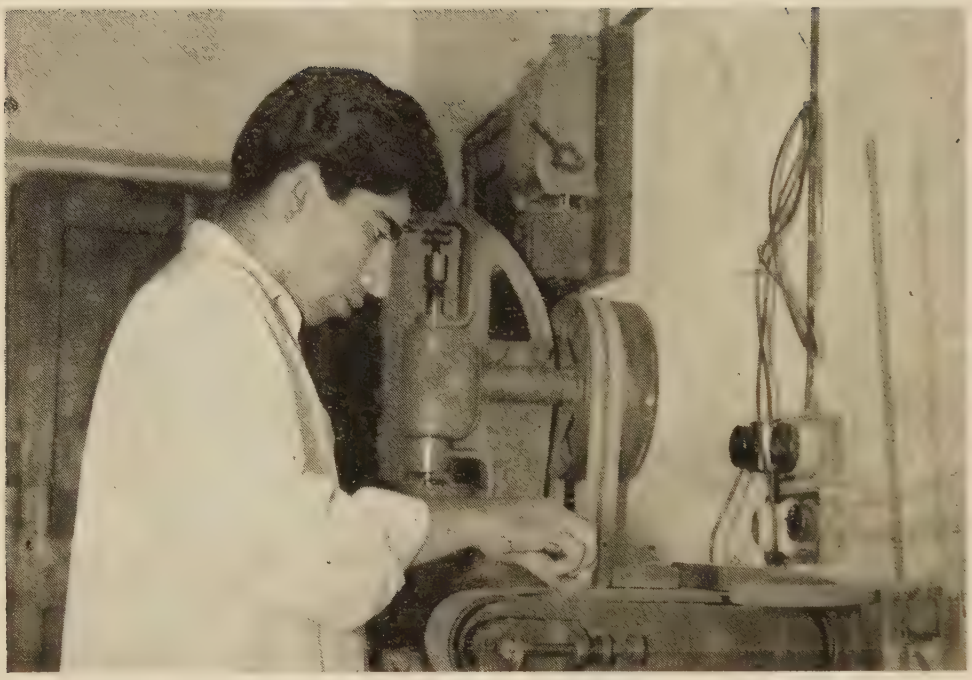
Project Associates: M. Ikram, M. Anisur Rahman and S.M.A. Kazmi.

5. *Tamarir gallica* Linn: The plant belongs to the *Tamaricaceae* family and grows in the former Punjab, Sind, Baluchistan and Frontier Province. Its galls contain obtain 40 per cent tannic acid and its twigs are used

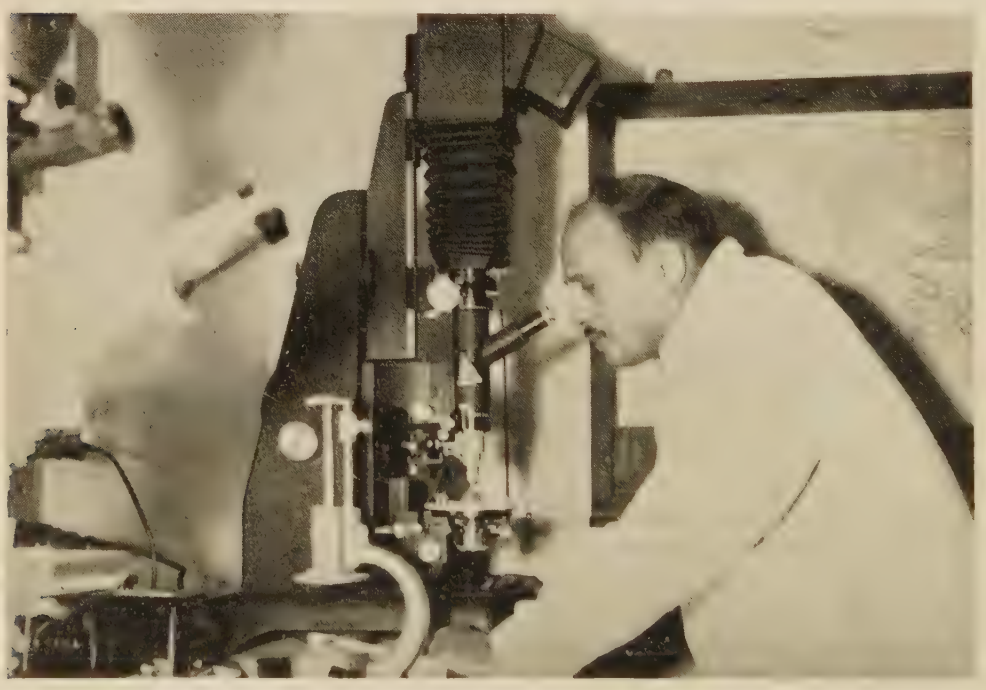


Dr. Mujahid H. Khan conducting an experiment on Frogs' rectus muscle in the Pharmacology Section, North Regional Laboratories.

Determination of the Tensile Strength of Wool Fibres in Wool Division, North Regional Laboratories.



Processing of minerals for physical examination in the Mineral Division, North Regional Laboratories.



Microscopic examination of minerals under various light arrangements in the Mineral Division, North Regional Laboratories.

for tanning purpose by the local people on a very small scale. The bark of this plant was analysed for its tannin content, and qualitative tests showed that it contains mixed type of tannins.

Total soluble content in water was found to be 17-18%, while the percentage of tannin is 60-65%.

The high percentage of tannin in the bark shows that it could also be used for tanning.

Project Associates: M. Anisur Rahman and M. Ikram.

6. *Rhazia stricia:* This plant is used in the indigenous system of medicine for arthritis, dermatitis and as a febrifuge. It is also used as a milk coagulant in Baluchistan. The leaves yield about 3.4 per cent of alkaloid. It was extracted with different solvents and one solvent has yielded a crude white product with a melting point 220-227°C. (Dec). Preliminary studies show the crude extract to be pharmacologically potent, possessing a sedative and hypotensive action. At present work is in progress to obtain the active principles in pure form.

Project Associates: M. Ikram and H.K.M. Abdul Hye.

7. *Zanthoxylum alatum:* This plant is known to be a fish poison. The alkaloids from the bark were subjected to chemical and pharmacological studies. Three solvents namely water, ethyl acetate and amyl alcohol were used for separation of the alkaloids, and ascending-and paper-chromatography was undertaken with the water soluble fraction using *n*-butanol: HCl: water (100:20: saturated with water) as solvent. (Whatman No. 1 paper inpregnated with IN HCl: was used).

Three fractions were obtained bearing the following Rf values:

Ascending chromatograpy: 0.41, 0.62 and 0.82.
Circular chromatography: 0.66, 0.84 and 0.98.

Further work is in progress.

Project Associates: M. Ikram, M. Anisur Rahman and H. K. M. Abdul Hye.

8. *Boucerosia aucheriana Decne* (*Asclepiadaceae*): Locally known as Charungli or Pamanke, it is a xerophytic herb found on the dry hills of the former Punjab, Waziristan and Baluchistan. Preliminary analysis of the plant shows that it contains some alkaloids.

An alcoholic extract of the herb, after certain purifications, was worked up for the isolation of the alkaloid, and the chloride of the alkaloid was isolated with a melting range 178-181°C. Further work on the isolation and properties of the pure base is in progress.

Project Associates: M. Ikram and M. A. Wahid.

9. Chemical Studies on Idigenous Drugs: While many useful herbs and drugs were being used indigenously before they were classed pharmacopoeial, never the less due to lack of research, some therapeutically unimportant drugs are still used in the indigenous system. So it was considered worth while to separate the good drugs from the useless ones. Therefore, systematic investigation of the following plants was started.

(*i*) *Fumaria parviflora* Lamk (*N. O. Fumariaceae*), known as Shahtara in Urdu, is a weed common in wheat fields throughout West Pakistan. It is considered to be diuretic, diaphoretic, alternative, tonic and blood purifier. Preliminary analysis reveals that the drug contains a considerable amount of potassium and ammonium salts in the form of nitrates and chlorides. Alcohol (95%) soluble extract was found to contain more than one per cent chloride and nitrate of potassium of which about 70% is KNO_3. So the diaphoretic and diuretic properties of the drug may perhaps be attributed to these inorganic salts. The drug also contains about 5 per cent glucose, tannin and alkaloids. On qualitative estimation, it was found to contain about 0.24% of total bases in fresh air-dried plant. By column chromatography initials bluish green florescent liquid was obtained which give long needle-shaped crystals in micro-quantity.

Paper chromatographic separation also showed the presence of more than one alkaloid. Further work on the characterisation of these fractions is in progress.

Project Associate: M. A. Wahid.

10. A Study of some indigenous Pharmacopoeial Herbs: Medicinal plants of great commercial and therapeutic value are known to occur in the North-Westrn part of West Pakistan. It was considered advantageous to explore the possibilities of their commercial exploitation and also to find out the proper season for their collection. *Podophyllm emodi* Wall, *Atropa acuminata* Royle ex Lindley, *Datura alba* Nees, *Datura fastuosa* L., *D. stramonium* L. and *Hyoscyamus niger* L. were collected from different localities at different dates and the drug samples were analysed according to standard pharmacopoeial assays. In view of their availability and quality, it was found that they can be used in the manufacture of galenicals and other medicaments. But the percentage of hyoscya-

mine in *D. alba* is comparatively low and suggestions have been made to improve its alkaloidal contents. An improved method for the estimation of resin in *Podophyllum* has also been discussed.

Project Associates: M. A. Wahid and S.M.A. Kazmi.

Publication: "A Study of Some Indigenous Pharmacopoeial Herbs" by M. A. Wahid and S.M.A. Kazmi. Accepted for publication in Pakistan J. Sci. Ind. Research.

11. A STUDY OF LOCAL AROMATIC HERBS: Some essential oil bearing herbs are either cultivated or are found wild in Pakistan. It was considered necessary to standardize them to find out their use in pharmacy and medicine. '*Anethum sowa*' Kuz (Sowa), *Foeniculum vulgare* Mill (Saunf), *Cuminum cyminum* Linn (Sufaid Zira) and *Carum copticum* Benth and Hook (Ajuwain) all belonging to the family *Umbelliferae* were selected for the present study. The drugs and their volatile oils were analysed according to the standard pharmacopoeial methods of the I. P. C. 1953 or B. P. 1953. The analytical values thus obtained revealed that these drugs or their essential oils are of standard quality. So they can be used in medicines by Hakims and allopathic practitioners as prescribed by the said pharmacopoeias.

Project Associates: M. A. Wahid and M. Ikram.

Publication: "Standardization of Some Local Aromatic Herbs" by M. A. Wahid and M. Ikram (Under publication).

12. STANDARDIZATION OF OFFICIAL AND NON—OFFICIAL DRUGS: Twenty-five official drugs including Indian Aconite, Colchicum, Male Fern, Rhubarb and *Cinnamomum camphora* Nees collected from different localities of West Pakistan were analysed for their active principles. The analytical values thus obtained were compared with the pharmacopoeial limits. It was found that most of them are quite rich in their active principles and that they can be used in pharmacy and medicine.

Project Associates: M. A. Wahid and Samiullah.

Publication: "Standardization of Active Principles of Indigenous Pharmacopoeial Drugs found in West Pakistan", by M. A. Wahid and Samiullah (under publication).

13. ANALYSIS OF 'TIMMAN' AND 'MOTILANE': Plants 'timman' and 'motilane' were received from the Department of Industries and Village-Aid for their analysis and to find out their use by the villagers.

On identification, it was found that 'timman' is *Suaeda fruticoss* Forsk and 'motilane' is *Salsola foetidah* Del. They both belong to the family, *Chenopodiaceae* and are commonly found as xerophytic herbs all over the plains of West Pakistan.

Preliminary analysis of the ash of 'timman' indicated the presence of silica, sodium, potassium, calcium, iron, magnesium and copper. The ash also contained lot of carbonates, sulphates, chlorides, etc. So it was inferred that it can be a good source of 'Sajji' or Barilla. The ash of the plant which is about 28 per cent was found to contain 75% of total soluble titrable alkali calculated as sodium carbonate. The ash of 'motilane' which is about 36% was found to contain about 38% of total soluble titrable alkali calculated as sodium carbonate. A method for the preparation of barilla from the plants has been suggested.

Project Associate: M. A. Wahid.

14. Ecological Studies on Berginia stracheyi— a source of tannin: Recently a root tannin material has attracted the attention of some workers. This material which is locally known as 'Chhapur' in Gilgit Agency is a mixture of the roots of *Berginia ligulata* and *Berginia stracheyi*. Preliminary investigations of the roots of *Berginia strachcyi* revealed that its roots have a potential value as a tanning material. They contain on an average about 25% tannin which is considered quite satisfactory from the commercial point of view. It is considered that in mixture with other tanning materials such as 'Babul', 'Wattle', etc., it should give a satisfactory tannage in the manufacture of heavy leather. Before any further step is taken in the exploitation of these roots for tanning purposes, it is considered necessary to have informations regarding their distinguishing characters as compared to other allied species, their habits and distribution, and the quantities of roots available for tanning industry. It was with these objects in view that this work undertaken.

Berginia ligulata and *Berginia stracheyi* are very common in West Pakistan. They differ in their habits and are found at different elevations and in associations with different groups of plants. Ecological studies on *Berginia stracheyi* reveal that the growth of *Berginia stracheyi* is poor at the elevation between 9,000 to 10,000 ft., better between 10,000 to 11,000 ft. and best above 11,000 ft. It prefers open sunny aspects. It associates with *Artemisia*, *Aconitum*, *Macrotomia* and *Morina* in the localities where its growth is quite profuse. These plants can be taken as indicators for selecting suitable areas for its cultivation. At present approximately 6000 tons of rhizome and 3000 tons of leaves can be collected from the Kaghan Valley only for the tanning industry. As it is quite difficult to take out the

roots completly from the soil, the possibilities of over extraction are mini mised. Still it is advisable that the roots may be extracted by rotation after every two years from each locality.

Project Associate: S. M. A. Kazmi.

Publication: "Some Botanical Observations on *Berginia stracheyi*- a source of Tannin." Pakistan J. Forestry Vol. X No. 2, 1960.

15. Drug Market Survey of West Pakistan: More than one thousand plants reputed for their medicinal properties are found in Pakistan. Most of these plants grow, mature and perish without being put to any practical use. It was considered essential that before undertaking scientific investigations on medicinal plants, the drug requirements of the country should be assessed properly.

To cover the first phase of the work, data regarding the consumption of different medicinal plants by the pharmaceutical industries were collected and drug markets of West Pakistan were surveyed. It was found that a number of medicinal plants indigenous in the country are not used in the industry and only a fraction of the natural product is exploited.

Project Associate: S. M. A. Kazmi.

Publication: A technical bullectin on the subject is under preparation.

16. Medicinal Plants' Herbarium and Museum: There is no medicinal plant herbarium and museum in the country where samples of drugs or plant specimens can be compared with the genuine ones. To make a beginning in this direction, attempts have been made to set up a small herbarium and museum of medicinal plants in these Laboratories. About 1200 plant specimens and 250 drug samples have been collected and identified so far. The work is in progress.

Project Associate: S. M. A. Kazmi.

17. Compilation of 'Notes on the Medicinal Plants of West Pakistan': To provide the scientific workers and industrial concerns with a comprehensive list of the medical plants containing correct botanical names, vernacular names, their distribution and habits, parts used, chemical contents and a comprehensive bibliography of the work so far undertaken on each plant, the compilation of notes on the medicinal plants of West Pakistan have been undertaken and is in progress.

Project Associates: S.M.A. Kazmi, M.A. Wahid and M.A.H. Afandi.

18. Cultivation of Medicinal Plants:

(*a*) Indigenous Drugs: A number of drugs indigenous to the country have been brought under cultivation at the experimental farm of these Laboratories. The following plants have been found to grow successfully:

1. *Anethum sowa*	2. *Datura fastuosa*
3. *Mentha piperata*	4. *Mentha longifolia*
5. *Lallmentia royleana*	6. *Lepidium sativum*
7. *Foeniculum vulgare*	8. *Chrysanthemum cinerariaefolium*
9. *Hyoscyamus niger*	10. *Hyoscyamus muticus*
11. *Ammi vesnaga*	12. *Curcuma longa*

(*b*) Foreign Species:

1. *Digitalis mariana*	2. *Digitalis laevigata*
3. *Symphytum officinalis*	4. *Digitalis lavata*
5. *Nepeta cataria*	6. *Datura stramonium* variety *intermus*
7. *Datura chlorantha*	8. *Melissa officinalis*
9. *Organum meriorana*	10. *Verbana histata*
11. Dill	12. Fennel

Project Associates: S.M.A. Kazmi and M.A.H. Afandi.

FRUIT TECHNOLOGY RESEARCH

1. Fruit Census: It is well known that commercial fruit growing depends upon a number of factors for its success. One of the important conditions is the presence of a well-organised fruit and vegetable processing industry to take care of surplus or otherwise unmarketable fruits and thereby to ensure a fair return to the growers and supply of fruit products at reasonable cost to the consumers. In order to develop the fruit processing industry on sound lines, it is essential to know the quantities of various varieties of different kinds of fruit grown in the region, their quality and seasons of availability. No reliable information is available from any source in this respect and a number of inquires were received by the North Regional Laboratories from the industrialists seeking advice on locations and capacity of fruit processing units which could be profitably established in the area. It was also desired to explore possibilities of export of some fruit products to European markets. A detailed fruit survey was, therefore, undertaken in 1957 in order to collect reliable data on the present production of fruits in the region and its future trends.

The survey in the Peshawar and Mardan districts has now been completed and the report will be published in the form of a bulletin.

Project Associates: C. M. Ishaq and J. N. Khattak.

2. ANALYSIS OF FRUITS AND VEGETABLES: The work started previously on analysis of fruits and vegetables grown in the region was continued in order to confirm previous observations and collect data on other varieties of fruits and vegetables.

Project Associates: C. M. Ishaq, J. N. Khattak, Fazal-ur-Rahman and N. A. Sufi.

3. MATURITY TRIALS ON CITRUS FRUITS: Maturity trials on different varieties of Malta oranges grown in the region were conducted with a view to suggesting standards of maturity for picking the fruit for table use, processing and cold storage. These data are urgently required by the industry.

Seven varieties, viz. Hamlin, Pineapple, Washington Navel, Ruby Red, Red Blood, Valentia and Temple were selected for these trials. A representative orchard in the citrus growing area was chosen and full bearing mature trees were earmarked. Samples were drawn at intervals of 10 days and variations in juice percentage, sugar, acid and vitamin contents were determined. The work was repeated during the fruit season of 1960-61 to confirm the observations previously recorded. The data have been compiled for publication.

Project Associates: C.M. Ishaq, J. N. Khattak and Samiullah.

4. UTILISATION OF FRUITS FOR PROCESSING:

(*a*) PLUM JAM: Observations made under 'Survey of Fruits in the North-West region of West Pakistan' clearly indicated that utilisation of some fruits, especially plums, for the manufacture of various products has become a serious problem for the fruit growers as well as for the manufacturers of these products. This problem is bound to assume greater significance as a result of increase in area under fruits in the near future. Experiments were, therefore, undertaken on the preparation and preservation of jams from different varieties of plums grown around Peshawar. Thirty-two lots of jams were prepared during the fruit season of 1957, 10 varieties of plum and thirty six lots from 12 varieties in 1958. During the period under report these jams were examined during storage by "cut-out" technique and also analysed for sugar, acidity, pH, total solids and degree of inversion.

The results indicate that jams of excellent quality can be manufactured from Formusa, Fazle Manani and No. 7 plums. These varieties when mixed with others in suitable proportions also gave jams of nice quality.

Project Associates: C.M. Ishaq, J.N. Khattak and Fazal-ur-Rahman.

(*b*) Citrus Squash: Squashes were prepared from different varieties of citrus fruits picked at different stages of maturity in order to determine the characteristics of varieties for preparation of squash and also the optimum stage of their maturity. The product was kept in storage and observations regarding taste, flavour, colour, etc., were recorded. Analysis were also conducted with a view to determining deterioration in the nutrition value of the products, particularly with regard to vitamin 'C' content. The data are being compiled for publication.

Project Associates: C. M. Ishaq, J. N. Khattak and N. A. Sufi.

(*c*) Pomegranate Syrup: The work on preparing pomegranate syrup as reported previously was continued. The syrup samples were kept in storage for observation and were examined for colour, taste and flavour by standard "cut-out" technique. The work will be continued with a view to effecting improvements in the quality of the products.

Project Associates: C. M. Ishaq, J. N. Khattak and Fazal-ur-Rheman.

(*d*) Mango Squash: Different varieties of mangoes obtainable from the local market were used for the preparation of squash by the method previously standardised. The behaviour of the product during storage was also studied. Some seedling varieties were found to give excellent squash with good aroma and flavour.

Project Associates: C. M. Ishaq and J. N. Khattak.

(*e*) Miscellaneous Products: Preliminary work on a number of products like guava jelly, grape wine, apple preserve, peach jam and apple jelly was undertaken with the view to utilising the fruits grown in the region. This will be extended during the next fruit season as a number of pilot plants and other necessary equipment are expected to be installed by then.

Project Associates: C. M. Ishaq, J. N. Khattak, Fazal-ur-Rahman and N. A. Sufi.

5. Utilisation of Industrial Wastes: Citrus peels are at present discarded as a waste by Food Preserving Industries. The wastage is quite high as the production of citrus fruit beverages has increased many-

fold in the country. An attempt was made previously to extract essential oil from citrus peels by cold pressing. During the period under report one of the cold expression methods namely the 'Sponge Method' was perfected and found suitable for the preparation of citrus oil. Some physico-chemical studies of the oil were also undertaken. The quality of the oil was found to compare favourably with the standards cited in the literature. The yield of oil varied from 0.3 to 0.9% in various fruits. It is felt that small and medium size factories can profitably utilise this method for the preparation of citrus peels as a by-product of squash manufacture.

Project Associate: Samiullah.

Papers Contributed:

1. 'Fruit Technology' by C.M. Ishaq—Proceedings 'Pakistan Science Conference', 1959.

2. 'Refrigeration of Fruits in Pakistan' by C.M. Ishaq—Proceedings F.A.O. Regional Seminar on Food Technology in Asia and Far East, Mysore, 1959 and Proceedings 'Pakistan Science Conference' 1960.

3. 'Problems of Food Processing in Pakistan' by C.M. Ishaq—Proceedings 'Pan Indian Ocean Science Association, 1960.

4. 'Survey of Fruits in North-West Region of West Pakistan'—Proceedings 'Pakistan Science Conference,' 1961.

Paper Accepted for publication:

5. 'Survey of Fruits in the North-West Region of West Pakistan' by C.M. Ishaq and J.N. Khattak (Pakistan Journal of Scientific and Industrial Research).

Paper Submitted for publication:

6. 'Physico-Chemical studies on the Essential Oil of Citrus Fruits' by Samiullah.

MINERALOGICAL RESEARCH

1. Iron Ores: Iron ore as haematite occurs in several places in Khyber agencies such as Jabba. Lashoora, Shalman and Tanga. Samples from these areas were subjected to detailed chemical analysis and all of them were found to be of low grade, the iron oxide content ranging from 20 to 50 per

cent. The silica in these samples forms a large part of the ore and is mostly in the form of combined silicates rather than being free as sands. Of the average total silica content of 30 per cent, more than 20 per cent is in the combined state.

Efforts were made to separate the silica by flotation and magnets, but it could not be done beyond a limited extent. Experimental cupola smelting also confirmed the chemical analysis as the whole charge of ore, coke and limestone turned into a stick mass completely blocking the furnace hearth.

Project Associates: Fazal Mohammad and Nabi Bukhsh.

2. Lead Ores: Lead Ores occur as galena in many areas in the Northern part of West Pakistan. Studies have been made on the lead contents and composition of these ores which showed that some of the samples are quite rich in lead contents.

Some interesting studies have been made on the trace amounts of silver present in galena and for that a colorimetric method for the determination of silver based on its reaction with *p*-dimethyl amino benzylidene rhodanin has been developed and standardized. The silver content of galena samples thus determined ranges from trace to 0.1 per cent.

The work is being continued to see whether silver can be extracted economically from any of these ores.

Project Associates: Akram Khattak and Nabi Bukhsh.

3. Beryl: Beryllium is gaining in importance in connection with its use in atomic research and the only commercial source of the metal is beryl, a silicate of beryllium and aluminium.

Some samples of the mineral were collected from Top Chupri in Hazara which gave the following chemical analysis:

Loss on ignition	—	0.8%
Beryllium oxide	—	11.2%
Auminium oxide	—	18.9%
Silica	—	64.2%
Iron oxide, Lime, Magnesia alkalis etc.	—	3.9%
Total	—	100.0%

Further investigations to find out the extent of these deposits and the ways and means of their commercial exploitation will have to be conducted in collaboration with the Geological Survey of Pakistan.

Project Associates: M. Hussain and Nabi Bukhsh.

4. Manganese Ores: A set of 6 samples of Manganese ores from Lasbela was received from the Secretary, P. C. S. I. R., Karachi for investigation. The samples were chemically analysed and one of the samples had a fairly high content of manganese dioxide (86.0%). As the sample was rather small in quantity and more material could not be made available the work could not be continued further. Another batch of manganese samples have been received from Amalgamated Mines Ltd. The samples are under preliminary studies.

Project Associates: Akram Khattak and Nabi Bukhsh.

5. Rock Salts: Rock Salts of varying qualities occur in fairly abundant quantities in West Pakistan. These salts are mostly used for edible purposes though in small amounts they are also used for curing of hides and skins, as animal feed and in the manufacture of caustic soda and Sodium carbonate. It was considered worth-while to study the wholesomeness of these rock salts, especially with regard to the trace impurities of copper, lead, iron, etc., present in them.

Good quality table salts which are being imported in Pakistan and some Pakistani brands have also been analysed. The results show that while all the foreign brands satisfy specifications for table salt, some Pakistani brands do not.

A simple and inexpensive method of purifying rock salt has been developed in the Laboratory. Pilot plant scale experiments on it will be undertaken shortly.

Project Associates: Fazal Mohammad and Nabi Bukhsh.

6. Survey and New Finds: Exploratory work and collection of mineral samples have been continued for the last two years and useful samples such as beryl, magnetite, ilmenite, graphite, marbles, bornites, mineral oils (in small quantities oozing out from a well in Warsak), haematite, mica, kaolin, calcite, feldspar, etc. have been collected.

7. Mineral Museum: The mineral museum has been further improved by the addition of several samples. Some important additions are:-

1. Bornite from Dir
2. Emerald from Swat
3. Fluorspar from Swat
4. Ilmenite from Dir
5. Beryl from Hazara
6. Rock Salts from Kheura, Bahadur Khel and Jatta
7. Galena from Bagra Mountains, Hazara
8. Graphite from Baghdera, Hazara
9. Green Sand from Geological Survey of Pakistan occurring in Hindubagh area
10. Chromite from Malakand Agency
11. Pyrolusite from Lasbela

Project Associates: Fazal Mohammad, M. Hussain and Nabi Bukhsh.

WOOL RESEARCH

The Wool Research Division started functioning during the second half of 1960. A detailed programme of work to be undertaken in this Division has been drawn up and orders for procurement of necessary equipment of the value of about Rs. two and a half lakh have also been placed. Important technical books and journals concerning Wool Technology have also been ordered. With the limited facilities available research work on the following items has been taken up.

1. Survey of Different varieties of Wool obtaining in the country with special emphasis on finding out possibilities for further development: Pakistan produces about 30-32 million lbs. of raw wool the major portion of which is exported as Carpet Wool. It earns a considerable amount of foreign exchange and ranks as the third major exportable commodity of the country. On the other hand foreign wool in the form of tops is being imported for consupmtion in our woollen Mills. The indigenous wool is obtained from about 17 different breeds of sheep. Lack of reliable data on the quality and physico-chemical properties of indigenous wool is a great handicap in the industrial exploitation of the material. The present work was undertaken to obtain such data and information.

During the autumn of 1960, Kaghan Valley, Swat State, Hazara, Mardan and Peshawar districts were surveyed. In this survey 14 full fleeces, 2 half fleeces and 8 small samples of Kaghani wool as well as 8 full fleeces and 4 small samples of Hashtnagri wool were collected for physico-chemical tests. Other field data connected with the survey were also collected. Further work is in progress.

A paper on 'Investigation on Kaghani Wool' is under preparation.

Project Associate: Maqsood A. S. Syed.

2. SURVEY OF EXISTING WOOLLEN AND CARPET MANUFACTURING FACTORIES WITH PARTICULAR EMPHASIS ON THEIR DIFFICULTIES AND PROBLEMS: The work was started in October, 1960 and data for one mill only have been collected so far.

Project Associate: Maqsood A. S. Syed.

3. PHYSICO-CHEMICAL STUDIES ON WOOL GREASE: Extraction of wool grease and its treatment to yield lanolin may be developed as an important by-product industry in Pakistan. Work has been started on the yield and the physico-chemical properties of wool grease obtained from different varieties of indigenous wool.

Preliminary investigations on Kaghani wool have shown that the body wool contains 2.9% of grease and skirtings 3.3%. The melting point of grease was found to be 31-35°C.

Project Associates: Maqsood A. S. Syed and M. A. Wahid.

VI

RESEARCH SCHEMES

RESEARCH SCHEMES

A brief account of the progress registered under specific Research Schemes, which continued during the years 1959 and 1960 is given below:-

1. CULTIVATION OF *Rauwolfia serpentina* BENTH AND (ii) LARGE SCALE PLANTATION OF *Rauwolfia serpentina* BENTH: According to a programme previously approved experiments were continued under the former scheme on the propagation of *Rauwolfia* plants under different spacings, soil and sand mixtures, and manurial combinations; on plants from stem cuttings; root cuttings, and leaf buds; and from seeds (including studies on propagation from freshly ripe and dried fruits, and from peeled seeds). Studies were also undertaken under this scheme on the yield of roots. As a result of continued experiments under the scheme, which was sanctioned by the Council in the year 1955 under Dr. S. Hedayetullah, formerly Liaison Officer, Ministry of Agriculture, Dacca, it has been possible to determine the conditions and methods for the extensive propagation of *Rauwolfia* plants in East Pakistan. Subsequently, another scheme, known as "Large Scale Plantation of *Rauwolfia serpentina* Benth", was also sanctioned under Dr. S. Hedayetullah in the year 1957, which aimed at exploring the possibility of introducing large-scale plantation of *Rawolfia serpentina* Benth in East Pakistan. Besides the great medicinal value of this particular agricultural product, its economic importance was also realised, as there exists a great demand for the roots by pharmacists in the U.S.A. and U.K. It was consequently felt that the country should benefit by the industrial processing of the roots. East Pakistan offers very favourable conditions for plantation of *Rauwolfia serpentina.* In view of the promising results achieved under the scheme, work on it is still continuing.

(*iii*) UTILIZATION OF JUTE AND JUTE WASTES: This scheme has been continuing under the supervision and guidance of Dr. M.H. Khundakar at the Dacca University from 1955. Under this scheme, experiments were carried out on (a) the specific oxidation to polyuronic acid which would be utilized as a rich source of furfural; and on the (b) drastic oxidation for the production of highly reducing oxy-cellulose. Products were yielded that can be condensed with phenol to produce resins. Work on the preparation of carboxymethyl cellulose from jute was also carried out and has been found suitable for further exploration. Studies are being conducted to improve the methods of degradation so as to make it cheaper and within the limits of commercial success.

(*iv*) Preparation and Biological Testing of Insecticides, Manufactured from Imported and Indigenous Ingredients: This scheme was sanctioned by the Council in 1954 and has since been continuing against yearly grants at the Karachi University, under the supervision and guidance of Dr. M. A. H. Qadri. During the period under review investigations were undertaken on the preparation and testing of vegetable oils for their insecticidal properties. The Artemisia, Taramira, Chenopodium and Gujran oils were tested. The artemisia oil has been found to be a most effective insecticide and proved to be non-phytotoxic to blossoms and flowering plants of agricultural and horticultural importance. This oil is an effective contact insecticide for killing all types of insects at a low concentration, a good stomach poison, and an effective larvicide to the extent of having about 95% to 100% mortality rate so far as mosquito larvae are concerned in 24 hours, without being unduly injurious to fish at low concentration. It also does not harm praqus, shrimps and crabs and other fresh water fauna. The Taramira oil also gave favourable results and was proved to be a good insecticide against many species of insect pests.

VII

INTERNATIONAL ASSISTANCE PROGRAMME

INTERNATIONAL ASSISTANCE PROGRAMME

1. EXPERTS: The Council of Scientific and Industrial Research has received help in the shape of experts under the Colombo Plan and from UNESCO. The following experts were assigned to this Council to work for a certain period in an advisory capacity:-

Under the Colombo Plan only one expert, Dr. Broadbent a pharmacologist, who was assigned to this Council and took up his assignment with the North Regional Laboratories in October, 1958, continued upto the end of the year 1959.

Under the United Nations Technical Assistance Programme, three experts, Mr. A. L. Gardner, Mrs. D. Loman and Mr. O'Halloran, continued their assignement in the Council with reference to the establishment and operation of PANSDOC. They were advising the Council on the PANSDOC project which has been catering to the requirements of the scientific workers of the country by supplying them with literature references in the form of bibliographies, photostat copies, microfilms and translations from other languages.

2. TRAINING FACILITIES: The information in regard to training facilities is as under:-

UNESCO:

Two of the Research Pharmacologists, who proceeded to UK in 1958 for advance training in their field of activity under Unesco Fellowships, have continued their training during 1959-60.

Two Documentation officers and one Translating Officer who proceeded on training abroad in their respective field of activity during 1958-59 have since returned.

F. A. O. :

Three candidates of the Council continued their training in Food Technology under FAO Fellowships in 1959 and two more proceeded abroad during that year. Two have since then returned and one has been granted study leave. The rest are expected back in 1961.

COLOMBO PLAN:

Under the Colombo Plan 6 Fellowships were provided in 1959 and 7 more in 1960. Against these facilities 9 have proceeded for training abroad (Appendix I).

FRANCE:

The Government of France have provided 5 training facilities in 1959. All the five candidates sent for training in France after they completed their training have been granted leave for higher studies in other Universities/ Institutions and are continuing their studies. Two more candidates have been sent for training in France against fellowships offered for 1960 (Appendix II).

GERMANY:

Three candidates have proceeded to Germany in 1960 against Scholarships offered by the German Government through the Ministry of Education (Appendix III)

JAPAN:

One candidate sent for training in Japan in Fuel Technology in 1959, continued his studies during the year 1960.

COUNCIL'S SCHEME:

While two candidates under Council's Scheme have been under training during 1959-60, one is still continuing his training. 10 more have been sent for training during 1960 (Appendix IV).

MISCELLANEOUS:

Five employees of the Council have proceeded abroad for higher studies under miscellaneous facilities offered to them during 1959-60 (Appendix v). Of them one returned in 1960.

STUDY LEAVE:

Apart from the training facilities under the various aid programmes mentioned above, thirteen employees of the Council have been granted study leave for higher training in their respective field of activity.

LIST OF THE FACILITIES MATERIALISED UNDER VARIOUS TRAINING PROGRAMMES DURING 1959-60

NAME OF THE PROGRAMME	FIELDS	NO. OF FACILITIES
	APPENDIX I	
COLOMBO PLAN	1. Organic Chemistry	1
	2. Plastics	1
	3. Pharmaceutical Chemistry	1
	4. Micro Analysis	1
	5. Building Material Research	1
	6. Food Technology	3
	7. Inorganic Chemistry	1
	Total	9
	APPENDIX II	
FRENCH	1. Inorganic Chemistry	1
SHORT-TERM	2. Organic Chemistry	1
FELLOWSHIPS	3. Chemical Industry	1
	4. Physics	1
	5. Fuel Technology	1
	6. Cement Technology	1
	7. Bio-Chemistry	1
	Total	7

APPENDIX III

GERMAN FELLOWSHIPS	1. Entomology		2
	2. Bio-Chemistry		1
		Total	3

APPENDIX IV

COUNCIL'S SCHEME	1. Chemistry		4
	2. Insecticides		1
	3. Maintenance of Equipment		1
	4. Mycology		1
	5. Microbiology		1
	6. Entomology		1
	7. Chemical Engineering		1
	8. Glass Technology		1
	9. Physical Metallurgy		1
		Total	12

APPENDIX V

MISCELLANEOUS	1. Food Technology		2
	2. Chemistry		1
	3. Biology		1
	4. Natural Science		1
		Total	5

VIII

SCIENTIFIC DOCUMENTATION AND PUBLICATIONS

SCIENTIFIC DOCUMENTATION AND PUBLICATIONS

Pakistan National Scientific & Technical Documentation Centre:

One of the aims of the Council relates to the collection and dissemination of published scientific and technical information. Pansdoc, the Pakistan National Scientific and Technical Documentation Centre, set up in 1957 under the aegis of the Council with the assistance of Unesco and the association of three Unesco expert advisers, covers this aspect of the Council's activities, as described below.

Pansdoc is still relatively new organization, and has suffered from various setbacks in the first two or three years of its operation. Under the previous (Quinquennial) report, it was possible to record a year of good headway in training the available staff and of continued heavy use of Pansdoc services. So far as the development of the centre was concerned, however, the situation was one of hope deferred rather than of good tidings. Moreover, the project was facing the inevitable dislocation of the work that would accompany an impending move to new temporary premises in the P.E.C.H.S., Karachi. However, a great improvement in the working of the whole Pansdoc project came in February 1959, when Dr. A. R. Mohajir, who had been with Pansdoc since April 1958 as Senior Documentation Officer, was officially placed in charge of Pansdoc operation and administration. Although Dr. Mohajir continued for some time in his post of Senior Documentation Officer, this step gave the Unesco Advisers the great advantage of a counterpart with whom they could collaborate closely and who had, moreover, already acquired a good basic knowledge of documentation work within the centre. With the steady and continuous cooperation of Dr. Mohajir in pursuance of the common aims, it has proved possible during the past two years to clear the major obstacles to the rapid advancement of the project.

Documentation section: The serious shortage of the documentation staff continued until mid-1959. Following a new advertisement, fresh interviews were held in Dacca and Karachi, and the resultant strengthening of the working cadre by the recruitment of two further junior Documentation Officers, Mr. G. Hamid Khan and Mr. A. Salam, together with the promotion of Mr. Akhtar H. Siddiqui to the grade of Documentation officer, opened the way for renewed development of this vital part of the centre's activities. Once the additional staff had been recruited, progress and develop-

ment in this section was quite rapid. The new Junior Documentation Officers trained themselves rapidly and were soon making a valuable contribution to the work. The stability of this part of the centre was also increased by the extension of the services of Mr. A.R. Ghani, as Senior Bibliographer, from May 1959 to May 1961. In spite of the reduction in the amount of detailed attention that Dr. Mohajir could give to the documentation work once he had been assigned the task of administering Pansdoc, the work load of document procurement and bibliography compilation has been successfully handled throughout the period.

Early in 1959, an additional Pansdoc service for dealing with Russian Literature was put into operation (as forecast in our report for the years ending 1958), under which Pansdoc subscribes to 16 of the English versions (produced in the U.S.A. and in U.K.) of the main Russian scientific journals. Content lists of these journals are sent to interested scientists in Pakistan who can then order from Pansdoc a microfilm or photocopy of any article appearing in the lists. Demands on this service have already resulted in the supply of copies of about 100 articles, and the demand is increasing as the new service becomes more widely known.

DOCUMENT REPRODUCTION SECTION: The document reproduction section passed through very many difficulties during 1959, and this continued well into 1960. As soon as the new Unesco adviser for this work, Mr. M. O'Halloran, arrived in May 1959, he was plunged into the task of planning and designing the photographic laboratories of the new temporary premises, which involved the conversion of semi-basement rooms of various kinds. Through the diligent cooperation of the C.S.I.R. engineer and Mr. O'Halloran, it was possible for Pansdoc to be transferred to these new premise in October 1959. The new photographic department is a great advance on the previous one, and at present matches up to the increased demands on this part of Pansdoc.

As mentioned above, the staff of this section was not up to adequate strength until mid-1960, and great difficulty had been experienced in keeping the work going, even with Mr. O'Halloran doing much of it himself. The present position is better and is improving further as the staff respond to training. Meanwhile, the amount of work has increased to such an extent that the clerical work involved in operating the section now requires the full-time attention of a suitably trained assistant.

An offset printing equipment has been ordered through Unesco, and preparations are being made for its accommodation. Some of the staff required for operating this equipment have alrady been recruited and are being trained in photo-reproduction techniques; the purely printing staff

Table I

REQUESTS FOR PANSDOC SERVICES

RECEIVED DURING 1959 AND 1960

	Microfilms		Photoprints		Bibliographies		Translations		Miscellaneous		Monthly Total	
	1959	1960	1959	1960	1959	1960	1959	1960	1959	1960	1959	1960
Jan. ..	120	50	49	33	14	41	11	15	—	—	194	139
Feb. ..	116	97	59	55	17	40	17	22	—	—	209	214
March ..	92	80	84	119	23	22	6	33	—	—	205	254
April ..	129	127	31	40	9	30	11	16	—	—	180	230
May ..	140	112	72	110	5	12	28	7	1	1	246	242
June ..	52	12	44	59	5	9	18	17	—	—	119	97
July ..	90	59	53	57	4	3	26	24	—	5	173	148
Aug. ..	43	52	35	132	5	4	8	23	—	1	91	212
Sep. ..	33	41	11	42	10	4	10	12	—	—	64	99
Oct. ..	68	46	80	60	3	3	10	5	—	—	161	114
Nov. ..	74	64	46	112	8	5	8	19	—	—	136	200
Dec. ..	134	63	38	113	5	8	3	11	27	—	207	195
	1091	803	602	932	108	181	156	204	28	7	1985	2127

Table II

PANSDOC TRANSLATIONS 1959-60.

Number of translations *completed* month by month and supplied to clients by PANSDOC from January 1959 to December 1960.

1959		1960	
January	7	January	5
February	9	February	5
March	5	March	7
April	5	April	10
May	7	May	—
June	—	June	7
July	5	July	6
August	3	August	8
September	3	September	7
October	1	October	3
November	5	November	12
December	6	December	11
Total ..	56	Total ..	81

Grand Total : 137

Table III

Analysis by languages of the translations *completed* and supplied to clients by PANSDOC from January 1959 to December 1960.

LANGUAGE	No.	LANGUAGE	No.
1. French	30	8. Hungarian ..	4
2. German	66	9. Portuguese ..	1
3. Russian	11	10. Afrikaans ..	1
4. Italian	5	11. Danish ..	2
5. Spanish	5	12. Dutch ..	1
6. Japanese	9	13. Hebrew ..	1
7. Czech	1		
		Total ..	137

will be recruited when the equipment is available for use, and it is hoped that its operation will enable the work of Pansdoc to proceed much faster.

TRANSLATION SECTION: Although definite progress was made in the translation section during the two years under report, it is still a long way from being able to function without outside help and to cover the demands made on it. The addition to the staff of a translator for Russian, Mr. Nasiruddin Humayun, was an encouraging step forward. Unfortunately the arrangements that were being made to nominate him for a 1960 T. A. Programme Fellowship, in order to perfect both his English and Russian, could not eventually be completed owing to his ill-health during the summer of 1960. Mr. Hafeez Siddiqui, who was originally recruited as French Translator, returned from his Unesco Fellowship in September 1960 with a very good knowledge of the German Language.

Further advertisements have so far failed to produce any acceptable candidates for staff translator posts or any sizeable body of usable panel translators for spare time translating work. It is hoped to avail some immediate arrangements for the training of translators by means of fellowship and to adopt interim measures for dealing with the translation demand.

Tables I, II, III give a synopsis of the work done by Pansdoc during the two years under review.

UNESCO FELLOWSHIPS: Two of the documentation staff received training abroad on Unesco Fellowships during 1959/60, namely, Mr. M. M. Rafique, Documentation Officer, from September 1959 to July 1960 mainly in England, and Mr. A. A. Biswas, Junior Documentation Officer, from February 1959 to October 1959, in Australia. Mr. Hafeez Siddiqui, Translating Officer, returned from his fellowship in September 1959. Mr. Sanaul Haque, Junior Photographic Officer, is starting on a twelve months fellowship in document photography on 2nd January, 1960. A programme has been prepared for Dr. A. R. Mohajir to take up in April 1961 the fellowship awarded to him for the study of scientific documentation service in various countries. As mentioned above, it was not possible to nominate Mr. Humayun, Translating Officer, for a 1960 T. A. fellowship. The nomination of Mr. Akhtar H. Siddiqui has been submitted for a fellowship in scientific documentation.

PANSDOC SUB-CENTRES: The programme for establishing sub-offices of Pansdoc in other parts of Pakistan has been taken up afresh, and action

is being initiated, on the basis of revised plans, for establishing one sub-office in Dacca and one in Lahore. The Pansdoc budget estimates for July 1961-June 1962 include estimates of funds for establishing and operating these two offices, which will help to expand very considerably the region of usefulness of Pansdoc.

PUBLICATIONS

Pakistan Journal of Scientific and Industrial Research

Another very important sector of the Council's activities is the publication of the researches, both fundamental and applied, carried out in its laboratories. While many of these have been published in a variety of scientific journals at home and abroad, with the rapid development of the Council's laboratories and the increasing volume of its publishable researches, the need for bringing out a Pakistan Journal of Scientific and Industrial Research had been increasingly felt. Accordingly the first issue of this Journal was brought out in January 1958, and it has since been appearing as a quarterly issue of about 80 pages.

During the first three years, i.e. 1958 to 1960, the Journal totalled 900 printed pages, which comprise over 150 original research papers, 14 non-technical notes, covering 14 pages, and two regular features, namely, Notes and News and Patent News, covering 50 pages. Towards the end of 1959, it has been found practicable to subdivide the research publications into full papers and short communications. The year 1959 was also marked by the publication of a combined April-July issue the "Rauwolfia Number", devoted to original researches on the mode of occurrence of the alkaloids of *Rauwolfia serpentina* their pharmacological properties, and the methods of culture of the plant, and also containing a comprehensive bibliography on the subject.

Analysis of Research Papers: Although the bulk of the contributions still emanate from the Council's laboratories, a sizable proportion is contributed by other research and technological laboratories in the Universities, Government Departments and Industrial Organizations. The yearly distribution of the papers by laboratories is given in the following table.

This table shows that on the average about one quarter of the papers have been contributed by laboratories other than those of the P.C.S.I.R.

Distribution of Papers by Laboratories

Central Laboratories			Regional Laboratories			Other Laboratories		
1958	1959	1960	1958	1959	1960	1958	1959	1960
39	18	24	8	9	21	15	10	11
Total = 81			Total = 38			Total = 36		

Also the contributions of the P.C.S.I.R. Regional Laboratories are seen to be increasing steadily in consonance with their development. there is a rather large drop in the contributions from the Central Laboratories in 1959 because the April-July issue was taken up entirely with the special "Rauwolfia Number" which included a comprehensive 80-page bibliography on this important subject, prepared by Messrs. A.R. Ghani and A. H. Siddiqui in the PANSDOC.

A subject-wise analysis of the papers published during the three years is given in the table below, and it shows a fairly even distribution between the fields of chemical, biological and physical sciences:

ANALYSIS OF PAPERS BY SUBJECTS

Plant Products and Organic Chemistry			Bio-chemical and Biological Sciences			Physics and Physical Chemistry			Oils, Fats, Paints and Plastics			Building Materials, Chemical Engineering and Inorganic Chemistry.		
1958	1959	1960	1958	1959	1960	1958	1959	1960	1958	1959	1960	1958	1959	1960
12	7	11	21	12	21	17	10	15	4	3	4	8	3	5
Total = 30			Total = 54			Total = 42			Total = 11			Total = 16		

The journal commands a good circulation (about 1,000) and is sent to the various institutions and libraries in 34 countries, 265 periodicals being received in exchange. Receipts through advertisements and subscriptions till the end of 1960 have grossed Rs. 16,028.

MISCELLANEOUS PUBLICATIONS

NORTH REGIONAL LABORATORIES, PESHAWAR

Mr. S. M. A. Kazmi, has contributed following 2 papers to the journals other than that of the Council's.

1. "Some Botanical Observations on *Berginia stracheyi* - A Source of Tannin." Pakistan J. Forestry Vol. X No. 2, April, 1960 (P-17-25).

2. " *Hoscyamus niger*-Its Cultivation and Commerce," Pakistan J. Sci. Research, January, 1960.

EAST REGIONAL LABORATORIES, DACCA

1. "Bitter Constituents from *Caesalpinia bonducella* Flem." By M. Erfan Ali and M. Qudrat-i-Khuda, in Chem. and Ind., 463(1960).

2. " The Structure of Castormine". By Z. Valenta and A. Khaleque, Tetrahedron letter No. 12PP—S, (1959) in Pergammon Press Ltd., Printed in Great Britain.

3. "Methyllyca Conitine." By A. Khaleque, S. Papadoponlos, I. Wright and Z. Valenta, in Chemistry and Industry PP. 513-514, (1959).

4. "C-Glycosyl Compounds - Part III. Carminic Acid," By M. A. Ali and L. I. Haynes, Journal of the Chemical Society in 1033, (1959).

5. "Cereals and Cereal Products". By M. N. Huq and N. A. Khan in Pakistan J. Bio. Agri., Sci., 3, 41, (1960).

6. "Cereals and Cereal Products I - Some Features of Starch varieties in East Pakistan." By N. M. Huq and N. A. Khan, in Pakistan J. Sci. Research. Vol. 13, No. 1, Jan. (1961).

7. "Studies on Indigenous Starches of Pakistan - Part I. Iodine Affinity Values of Indigenous Starches and Assessment of their Amylose and Amylopective Contents." By M. Qudrat-i-Khuda, H. N. De and Md. Yasin, in Pakistan J. Sci. Research, Vol. 12, No. 4, October, (1960).

WEST REGIONAL LABORATORIES, LAHORE

1. 'A Comparative Study of ' Amla Products' and Synthetic Antioxidants for Edible Fats.' By Iftikhar Ahmad, Muhammad Khurshid Bhatty, Karimullah and Muhammad Akbar Saeed. Pakistan J. Sci. Research 12, 2 (1960).

2. 'Elimination of Distillation Step in the Kjeldahl Method for the determination of nitrogen in Agricultural and Animal products.' By Muhammad Ashraf, Muhammad Khurshid Bhatty and R. A. Shah. Pakistan J. Sci., Research, 12, 3, (1960.)

3. 'Chemical Investigations on the Fat of *Cucumus momordica.*' By Shafiq Ahmad Khan, M. K. Bhatty and Karimullah. Pakistan J. Sci., Research, 12, 4, (1960).

4. 'A Rapid Method for the Determination of oil in Oil Bearing Materials without the Soxhlet or Butt Extractors.' By M. K. Bhatty, Karimullah and Shafiq Ahmad Khan. Pakistan J. Sci. Research, 12, 1, (1960.).

5. 'Quantitative Aspects of the Base-Catalysed Bromination of Acetaldehyde.' By Muhammad Umar, Ehsan Ali and M. H. Hashmi, Pakistan J. Sci., Research, 12, 3, (1960).

CENTRAL LABORATORIES, KARACHI

BIO-CHEMICAL RESEARCH DIVISION

1. S. Mahdihassan. Iron—Carbohydrate Complexes Arzneimittel—Forschung, 9 : 720—21 1959.

2. S. Mahdihassan. The Probable Origin of Kekule's Symbol of the Benzene Ring. Scientia, 54 : 1—6 (3 figs.) 1960.

3. S. Mahdihassan. Notes on Aphrostobracon flavipennis. Bulletin of Entomology, 1 : 22—24 (4 figs) 1960.

4. S. Mahdihassan. Das hermetische Siegel. Pharmazeutische Industrie, 22 : 92—94 (2 figs) ; 1960 .

5. S. Mahdihassan On Alchemy, Kimiya and Iksir. Pakistan Philosophical Journal' 3 : 67—88; 1959.

6. S. Mahdihassan. Lemnian Tablets. Iqbal, July 9 : 49—57 (10 figs); 1960 .

7. S. Mahdihassan. Genesis of Alchemy. Indian J. History of Medicine. 5 : 41—47 ; 1960.

PESTICIDE RESEARCH DIVISION

1. S. H. Ashrafi. 'Toxic Potentiality of Makerol.' Section of Chem. Pakistan Association for the Advt. of Science, PP.28. (1955).

2. S. H. Ashrafi. 'Studies of Pepsin-like Enzyme in the Stable fly, *Stomoxys calcitrans.*' Proc. Sixty seventh Annual meeting, Ohio Academy of Science, PP.3 (1958).

3. S. H. Ashrafi. 'Phosphatase activity in the stable fly, *Stomoxys calcitrans.*' Bull. Ent. Soc. Am., PP. 84 (1958).

4. F. W. Fisk, E. N. Lambrement and S. H. Ashrafi. 'Pepsin-like Enzyme in the Larvae of Stable Flies.' Science, 129: 1484. (1959).

5. S. H. Ashrafi and F. W. Fisk. 'Histochemical Localization of Acid and Alkaline Phosphatases in the Stable Fly with Napthol AS-Phosphate.' Bull.' Ent. Soc. Am., PP. 120. (1959).

6. S. H. Ashrafi. 'The Study of Phosphomonoesterases in the stable Fly, *Stomoxys calcitrans.*' Desser. Abs., 21 : 994. (1960).

PHYSICS DIVISION

1. " Some Factors Affecting the Gain and Resolution of Photomultiplier tubes ", by R. D. Conner and M. Khursheed Husain. Nuclear Instruments and Method 6, 337—342 (1960).

IX

PATENTS AND RESEARCH UTILIZATION

PATENTS AND RESEARCH UTILIZATION

During the period under review, 15 patents have been obtained, and applications for another 3 are pending in the Patent Office. In addition to the Patents reported in the Quinquennial Report on pages 199—201, patents on applications filed in 1957-1958 on 7 inventions have been accepted.

"Pakatol" and "Jutoid" have been registered and application for "Cemto" is awaiting acceptance. At regular hearings, arguments for recognising the Council as a body entitled to obtain registration of trade marks were heard in the "Cemto" application by the Registrar of Trade Marks, and the judgment was given in favour of the Council.

PATENTS

A. Patents obtained on application filed during 1959 and 1960:

1959

A process for the manufacture of mineral oil-based printing inks. Salimuzzaman Siddiqui and M. Aslam. Pakistan Patent 109840, October 12, 1959.

A process for the production of a composition for preparing water-proof cement plaster and slabs. M. Aslam and S. J. Quadir. Pakistan Patent 109599, October 12, 1959.

Reduction of ferruginous clay containing iron ores with earth gas, hydrogen, carbon monoxide or mixtures of reducing gases. George Hahn and Syed Ishtiaq Ali, Pakistan Patent 110324, October 19, 1959.

A process for producing spinnable fibre from jute cuttings. Salimuzzaman Siddiqui, M. Qudrat-i-Khuda and A. R. M. M. Manzur-i-Khuda. Pakistan Patent 110185, December 9, 1959.

A process for the treatment of kumbi leaves (*Careya arborea Roxb*) for use in rolling tobacco in Bidi manufacture. M. Qudrat-i-Khuda, M. A. Saboor and Habibur Rahman. Pakistan Patent 109798, December 9, 1959.

1960

A process for isolating jute seed oil, strophanthidin and raffinose from jute seeds. M. Qudrat-i-Khuda, Abdul Khalique and D. C. Das. Pakistan Patent 110064, March 8, 1960.

A process for the manufacture of a starch adhesive. Ehsan Ali, M. H. Hashmi and Karimullah. Pakistan Patent 110116. April 4, 1960.

A method of making gelatin printing-roller composition. Ehsan Ali, M. H. Hashmi and Karimullah. Pakistan Patent 110066, April 4, 1960.

A process for the manufacture of a starch adhesive for use on high-speed production equipment. Ehsan Ali, M. H. Hashmi and Karimullah. Pakistan Patent 110026. April, 4, 1960.

A method of drying animal blood. M. Saeed and Karimullah. Pakistan Patent 109880, April 4, 1960.

A process for the production of a water-resistant glue from animal blood. M. Saeed and Karimullah. Pakistan Patent, 109893, April 4, 1960.

A process for the production of Turkey-red oil. Shafiq Ahmad Khan, M. K. Bhatty, Karimullah and Salimuzzaman Siddiqui. Pakistan Patent 110117, April 4, 1960.

A process for the manufacture of ferrocyanide blue. A. R. Chughtai, Iqbal Ahmad and Karimullah. Pakistan Patent 110367, July 22, 1960.

A process for the production of soluble acetates of aluminium. A. R. Chughtai, Iqbal Ahmad and Karimullah. Pakistan Patent 110388, July 22, 1960.

A process for the preparation of a fish flour from the meat of elasmobranch fishes. S. Mahdihassan and S. A. Haq. Pakistan Patent 110391, October 3, 1960.

B. Applications filed : A process for the preparation of brazing flux for use at high temperatures. A. H. M. Zia-ul-Haq, M. G. A. Biswas and Karimullah. Pakistan Application 271/60, April 4, 1960.

A Method for the clarification of cane molasses for use in the manufacture of yeast. A. F. M. Ehtasham-ud-din, M. Saeed and Karimullah. Pakistan Application 272/60, April, 4, 1960.

A process for the production of rosin esters of betulin, and coating composition prepared therefrom. Salimuzzaman Siddiqui, M. Aslam and K. Alam. Pakistan Application 824/60, September 27, 1960.

C. In addition to the patents reported in the Quinquennial Report 1953-1958 (pp. 199-201), the following patents on applications filed in 1957-58 have been accepted during 1959-1960:

A process for the simultaneous production of refined shark liver oil and vitamin A concentrates along with the recovery of other therapeutically active by-products. S. Mahdihassan, M. Moinuddin, S. Maqsood Ali and S. Abdul Haq. Canadian Patent 601,339, April 13, 1957.

A process for the production of cottonseed oil-based coating compositions. Salimuzzaman Siddiqui and M. Aslam. Canadian Patent 952,615, April 13, 1957.

Improvements in or relating to emulsion type mimeograph ink and a new stabiliser therefor. Salimuzzaman Siddiqui and M. Aslam. British Patent 834,311, May 20, 1957.

A process for the isolation of alkaloids and alkaloidal complexes from *Rauwolfia* species of plants. Salimuzzaman Siddiqui. Canadian patent 609,833, July 5, 1947: Japanese Patent 30,611, December 10, 1957.

Improvements in or relating to an "Angethi" using charcoal or soft coke. Late Lt. Col. M. Ishaq and C. K. Ilahi. Pakistan Patent 109,362, May 19, 1958; Indian Patent 65,344, September 23, 1958.

Improvements in or relating a composition and a process for the production of water-proof sheets. Salimuzzaman Siddiqui, M. Aslam and A. Mehdi. Pakistan Patent 109,344, September 8, 1958; Indian patent 65,207, September 11, 1958.

Improvements in or relating to a process and an apparatus for the production of water-proof sheets. A. H. Chotani and S. M. Ishaq Ali. Pakistan Patent 109,346, November 10, 1958; Indian Patent 65,866, November 18, 1958.

TRADE MARKS

"Jutoid". Registration No. 27118 dated March 11, 1957, sealed on September 26, 1959. Class 27.

"Pakatol". Registration No. 27117 dated March 11, 1957, sealed on March 22, 1960. Class 19.

"Cemto". Application No. 32081 dated January 13, 1960. Class 19.

INDUSTRIAL PROCESSES DEVELOPED BY THE PAKISTAN COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH:

Considerable progress has been made with regard to the commercial development of a number of processes evolved under the Council, as mentioned in the earlier (Quinquennial) Report. Special mention may be made of the processes relating to (1) "Jutoid" Matting, (2) "Cemto" and (3) Petrol Gas Plant. The party selected for "Jutoid" Matting started production over a year ago and produced about 7,00,000 sq. ft. of matting. The parties selected for "Cemto" and Petrol Gas Plant have also started production. There has been an appreciable demand for "Cemto" especially from the Pakistan Public Works Department.

The parties selected for the processes relating to (1) Manufacture of Shark Liver Oil and Vitamin A Concentrates, (2) Printing and other Oil - based Inks, (3) Manufacture of Fountain Pen Inks and (4) Manufacture of Heat and Sound Insulation Boards from Sugar Cane Bagasse and other Agricultural Wastes, have nearly completed preliminary arrangements and are expected to be able to start production soon. During the period under review a new process relating to ' Dried Slaughter House Blood ' (preparation of dried products suitable for fertilizers and animal feeds and water resistant glue for plywood industry as well as light coloured glue suitable for different industries), was evolved at the West Regional Laboratories, Lahore and given to a local firm on a trial basis. A keen interest has been shown in this process by a number of parties. The following new processes developed in the laboratories of the Council during the period under review are ready for being leased out for commercial development.

(1) Dry Distemper, (2) Wood Preservative, and (3) Wood Chip Board. Details of these processes are given in the relative non-technical notes printed elsewhere in this volume.

NON-TECHNICAL NOTE

ON

"JUTOID" WATER PROOF MATTING

Water-Proofing of roofs is a necessity in a great many cases where light concrete, thatched roofings or damp proof courses are used. Uptil now these demands have been met by importing certain products, which are a drain on the foreign exchange and are too highly priced to be directly available for the masses or for refugee rehabilitation. A process has been evolved at the Central Laboratories, Pakistan Council of Scientific and Industrial Research, for the production of a cheap water proof matting of jute fabric base and other indigeneous raw materials with the help of simple equipment which can be locally fabricated.

This material has been tested to withstand the severity of temperatures of the order of 170°F without any bleeding and has also been subjected to water-jet quenching for determining thawing effects. Besides, it has been exposed to local climatic conditions for considerable period without appreciable deterioration.

The total estimated capital investment for a plant with an annual production capacity of 6,00,000 sq. ft. Jutoid Matting is Rs. 1,29,291/-. The cost of production of the matting works out to As. 0-3-6 per sq. ft. The prevailing prices for the material used for similar purposes fluctuate between As. 0-12-0 to Rs. 1-0-0 per sq. ft.

PRE-CONSTRUCTION COST ESTIMATION

I. Capital Expenditure

A. *Equipment*

	No.	Rupees
1. Portable boiler cap. 250 gal.	1	3,000/-
2. Hessian winders 4.5′ long 5″ dia.	2	300/-
3. Steeping tank cap. 30 gal.	1	500/-
4. Press rolls :		
(*i*) 5.5′ long $2\frac{3}{4}$″ dia.		
(*ii*) 5.5′ long 7″ dia.	1	1,500/-

	No.	Rupees
5. Jutoid winders 4.5′ long 5″ dia.	2	300/-
6. Vibrating sieve 4′ long 10″ broad	1	500/-
7. Rollers	2	300/-
8. Gas plant 300 cu. ft.	1	2,500/-
9. Harison water pump	1	1,000/-

B. *Building*

30′ × 60′ including Plumbing, Sanitary and Electrical fittings		7,000/-
	Rs.	16,900/-

II. Running Expenditure

A. *Raw Materials*

	Qty/day	Cost/day	Cost/year in rupees
1. Hessian cloth	220 yds.	110/-	33,000/-
2. S. P. B.	550 lbs.	110/-	33,000/-
3. F. E.	180 lbs.	20/-	6,000/-
4. C. S. D.	60 lbs.	50/-	15,000/-
5. S. O. Sbp/120	3 gal.	5/-	1,500/-
6. Fuel (Wood)	6 mds.	24/-	7,200/-
7. Water	3000 gal.	6/-	1,800/-
		Rs.	97,500/-
For 3 months,		Rs.	24,375/-

B. *Direct Labour*

	Rupees per mensem	Rupees
1. Tech. Asst.	450/-	5,400/-
2. Mechanic	150/-	1,800/-
3. Labourers (3)	75/-	2,700/-
	Rs.	9,900/-
For three months,	Rs.	2,475/-

C. *Indirect Labour (Establishment)*

		Rupees per mensem	Rupees
1.	Manager	500/-	6,000/-
2.	Accountant-cum-clerk	250/-	3,000/-
3.	Chowkidar	60/-	720/-
			Rs. 9,720/-
	For 3 months,		Rs. 2430/-

D. *Selling Expenses*

		Rupees per mensem	Rupees
1.	Sales Asst.	150/-	1,800/-
2.	Sales Representative inclusive of T. A.	200/-	2,400/-
			Rs. 4,200/-
	For 3 months,		Rs. 1050/-

E. *Miscellaneous*

	Rupees
Packages	1,000/-
Power	1,000/-
Office expenses	1,000/-
Interest on capital on Rs. 50,000 at 4%.	2,000/-
Contingencies	1,000/-
	Rs. 5,000/-
For 3 months,	Rs. 1250/-

COSTING

1. Direct Expenses	*Rupees per annum*
Raw materials	97,500/-
Direct wages	9,900/-
Power	1,000/-
Contingencies	1,000/-
Depreciation at 10% on Rs. 16,900/-	1,690/-

	Rupees
2. INDIRECT EXPENSES	
Establishment	9,720/-
Promotion of the project at 2½% on Rs. 50,000/-	1,250/-
3. SELLING EXPENSES	4,200/-
4. INTEREST ON CAPITAL at 4% on Rs. 50000/-	2,000/-
5. INSURANCE at 2½% on Rs. 41,275/-	1,031/-
	Rs. 1,29,291/-

AVERAGE COST OF PRODUCT

Total Cost of Producing 6,00,000/- sq. ft. of Jutoid comes to Rs. 1,29,291/-/-

INCOME

Cost of production per sq. ft. As. 0/3/6

	Rupees
Total running expenditure	31,530/-
Total capital expenditure	16,900/-
Total capital investment	Rs. 48,430/-
Say,	Rs. 50,000/-/-.

NON-TECHNICAL NOTE

ON

CONCRETE WATER PROOFING COMPOSITION

"CEMTO": A composition based mostly on indigenous raw materials has been developed at the Central Laboratories for rendering cement water proof. It has been found to be especially suitable for application concrete floors and walls that are exposed to scopage through sub-soil water.

3% of the composition based on concrete is sufficient to impart water proofing qualities. One inch thick concrete slabs made with Cemto were compared with these containing similar compositions available in the market in respect of water percolation test. The results were as follows:-

Specimen	*Water percolation cc/sq. ft. per hour*
1:3 ordinary concrete	508
1:3 concrete with 3% of the best imported products	14.25
1:3 concrete with 3% Cemto	11.5

The total capital investment for a plant producing 3,00,000 lbs. of the product annually is estimated at Rs. 1,07,890/-. On the basis of this unit of production the cost of Cemto packed in tin containers works out to Rs. 0-8-0 per lb. Further reduction in the price can be effected if it is supplied in gunny bags or double walled thick paper. The prevailling price of similar water proofing agents sold in 8 lbs. tin is Rs. 1-12-0 per lb.

PRE-CONSTRUCTION COST ESTIMATION

Daily production of 1,000 lbs.

I. CAPITAL EXPENDITURE

A. *Equipment*

1 Kettle	1	cap. 45 gal.	Rs. 1,000/-
2 Tanks	3	cap. 100 gal.	Rs. 1,500/-

		Rupees
3	Precipitating tanks with stirring arrangements	1,000/-
4	Ball mill (to handle 1000 lbs.	4,000/-
5	Lab. & Miscellaneous	2,500/-
		Rs. 9, 500/-

B. *Building*

				Rupees
1	Shed	240	sq. ft.	
2	Processing room	600	.. ..	
3	Store—raw material	500	.. ..	
4	Store—finished product	500	.. ..	
5	Office manager	240	.. ..	
6	Office general	240	.. ..	
		2,320	.. ..	23,200 -
				Rs. 32,700/-

II. Running Expenditure

A. *Raw Materials*

			Rupees
1	Filler	2,70,000 lb. at 1 as. lb.	16,875/-
2	Oils & rosin	2,700 lb.at Rs. 1/- lb.	2,700/-
3	Chemicals	450 lb. at Rs. 2/-lb.	900/-
			Rs. 20,475/-
	For 3 months,		Rs. 5119/-

B. *Direct Labour*

			Rupees per mensem	*Rupees per annum*
1	Asst. Chemist		250/-	3,000/-
2	Operator		125/-	1,500/-
3	Lab. Attendant		60/-	720/-
4	Labourers	(8)	each Rs. 3/day	7,200/-
				Rs. 12,420/-
	For 3 months,			Rs. 3,105/-

C. Indirect Labour (Establishment)

		Rupees per mensem	Rupees
1	Manager	300/-	3,600/-
2	Accountant	200/-	2,400/-
3	Chowkidar	60/-	720/-
			Rs. 6,720/-
	For three months,		Rs. 1,680/-

D. Selling Expenses

		Rupees per mensem	Rupees
1	Sales Asst.	150/-	1,800/-
2	Sales Representative	200/-	2,400/-
			Rs. 4,200/-
	For three months,		Rs. 1,050/-

E. Miscellaneous

		Rupees
Packages	Tin cap. 8 lbs. at 1.8/- per tin (37,500 tins annually)	56,250/-
Power		480/-
Office expenses		480/-
Interest on capital at 4% on Rs. 60,000		22,400/-
Contingencies		480/-
		Rs. 60,090/-
For three months,		Rs. 15023/-

NON-TECHNICAL NOTE

ON

PETROL GAS PLANT

A regular supply of gas is one of the essential requirements of a laboratory. The gas is ususally obtained from the city gas supply, or generated in large plants of Mansfield type, installed at site. So far there is no city gas available anywhere in Pakistan and although with the discovery of the Sui Gas it is expected that gas will be available for domestic consumption in some of the cities, an independent gas plant will continue to be a necessary item of laboratory equipment. While some of the larger institutions have installed Mansfield type gas plant, most of the smaller industrial laboratories, have been experiencing considerable difficulty in this respect. During the last few years imported gas plants of the Aerogen type have been obtained at considerable cost from abroad, but on account of the fact that even a small size gas plant sufficient for 60 burners costs about Rs. 8000/-, a good part of which amount represents foreign exchange, a large number of smaller institutions have practically no arrangements for supply of gas. In order to meet this requirement the Chemical Engineering Section of Central Laboratories of the Council of Scientific & Industrial Research took up the design and fabrication of a portable and low-cost gas plant. The gas plant, of which many units have already been fabricated in the workshop of the Laboratories, has the following general specifications:-

1. 500 cu. ft. gas/gallon petrol.
2. 300 B.T.U./cu. ft. of gas.
3. 300 cu. ft. gas/hr. for 60 burners.
4. Overall dimensions: 4′-8″ × 2′-4″ × 5′-2″.
5. Power required: 185 watts.

The cost of the plant has been worked out to be about Rs. 1300/-. All parts of the plant can be fabricated except a high speed motor which will have to be imported. On the basis of comparative performance under similar conditions, the gas plant fabricated in the Council has been found to possess many advantages over similar imported gas plants. Some of the special features of the plant are that it gives a longer flame, takes less time to generate the same quantity of gas, maintenance is easier, wear and tear is much less and the gas plant is more compact, requiring much less floor space compared to imported gas plants of the same capacity.

The fabrication of the gas plant can be taken up in any good workshop at an estimated cost, as indicated below:-

PRE-CONSTRUCTION COST ESTIMATION

I. Direct Charges

		Rs.	Rs.
A.	1. M. S. sheets and other materials	250/-	
	2. Fabrication of carburetting unit	100/-	
	3. Driving unit and accessories	300/-	
			650/-
B.	Labour		300/-
			950/-

II. Indirect Charges

1. Overhead charges	125/-	
2. Electric charges	50/-	
3. Depreciation on machinery	50/-	
4. Contingencies at 5% on labour & material	50/-	
5. Miscellaneous	75/-	
		350/-
Total Rs.		1300/-

Cost of production of Petrol Gas Plant Rs. 1300/-

NON-TECHNICAL NOTE

ON

SHARK LIVER OIL AND VITAMIN A

CONCENTRATES

Fish fauna of the Arabian Sea is a natural resource of great significance in the economy of Pakistan. The long West Pakistan coast offers exceptionally good opportunities for developing fisheries on a commercial scale. Along with the edible fishes a considerable number of sharks are landed throughout the year mostly at four or five coastal fishing villages along the Makran coast and around Karachi.

Shark liver oil is known to be a rich source of Vitamin A. There are several other marine fishes that contain Vitamin A in their livers. To name a few, cod, hallibut, sword-fish etc., are exploited for the extraction of liver oil which is sold in the world markets after necessary refining and standardization. Pakistan imports large quantities of such liver oils for its Vitamin A and D content along with other preparations containing synthetic Vitamin A, and the country thus incurs a considerable amount of foreign exchange expenditure.

In view of the facts stated above, investigations were started over a year ago in the Central Laboratories of the Pakistan Council of Scientific and Industrial Research to study the possibilities of developing Shark liver oil industry in the country. As a result of these studies a process has been evolved for the simultaneous production of concentrates of Vitamin A with a potency of around 1 million U. S. P. units per gram, and a deoderized, decolorized oil with a standardized Vitamin A content of around 7000 U. S. P. units per gram. After completion of laboratory experiments the economics and optimum working condition of the process have been thoroughly studied on a pilot plant.

The total capital investment for a unit with an annual production capacity as given below is estimated at approximately Rs. 3,30,000/-.

1. Refined Shark liver oil, 7000 U. S. P. units per gram, approximately 16,800 lbs.

2. Vitamin A concentrate, 10,00,000/- U.S.P. units per gram, approximately 34 lbs.

3. Emulsion, 2,400 U. S. P. unit per gram, approximately 40,000 lbs.

Total Vitamin A content of the above products will be approximately 73 thousand million U. S. P. units, giving an average cost of Rs. 0/5/6 for 1,00,000/ U. S. P. units of Vitamin A.

The retail market price of imported Cod Liver Oil e. g., Seven Seas Cod Liver Oil, is Rs. 1/12/- for 8 oz. containing 1,60,000 U. S. P. units of Vitamin A and 20,000 U. S. P. units of Vitamin D.

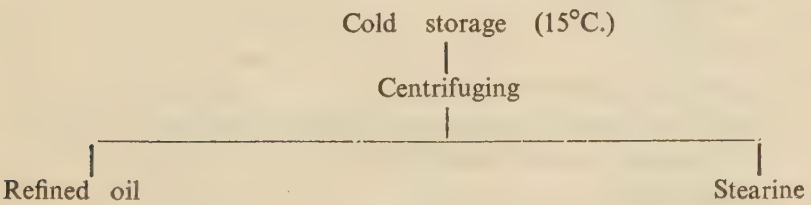
If it is desired to produce an oil with both Vitamin A and D, the latter may be added in the form of calciferol, at an additional cost of Rs. -/5/- for 20,000 U. S. P. units of Vitamin D, giving the cost of the finished product comparable to Seven Seas Cod Liver Oil as below :—

1,60,000 U. S. P. units of Vitamin A in Shark liver oil	Rs. -/9/-
Additional cost of Vitamin D, 20,000 U. S. P. units	Rs. -/5/-
Total	Rs. -/14/-

PROCESS

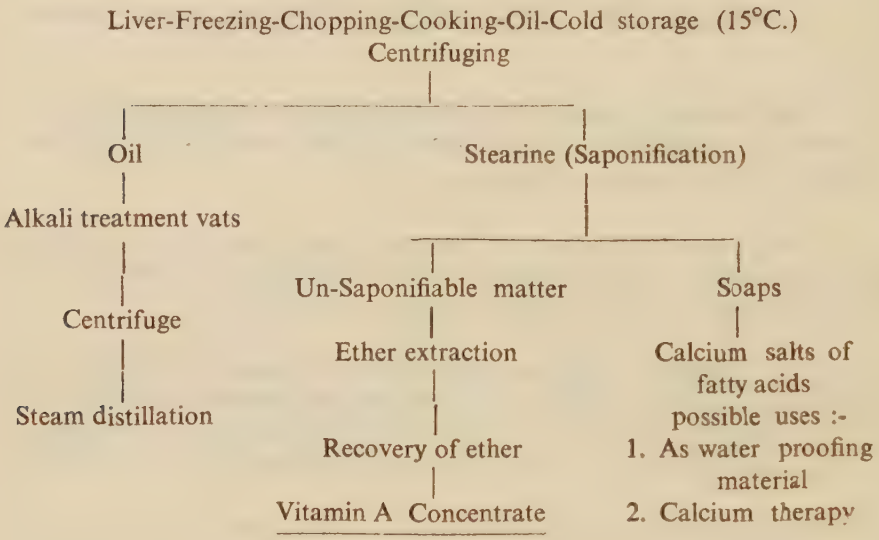
The process follows the flow sheet given below :—

Shark Liver→Freezing (-4°C)→Chopping→Cooking→Oil→Alkali treatment→Centrifuging→Steam distillation under reduced pressure.



Preparation of Shark liver oil emulsion

A part of the oil can be used for the preparation of Vitamin A concentrates as given in the flow sheet below :—



EQUIPMENT

The equipment required consists of the following :—

1. Refregeration units for cold storage
2. Liver Chopper
3. Steam jacketted cooking pans
4. Sharples centrifuge
5. Alkaline treatment vats
6. Steam distillation apparatus
7. Crude oil electric generator
8. Overhead tanks
9. Boiler
10. Capsulating machine
11. Spectrophotometer and other analytical equipment for the testing and standardization laboratory
12. Homogenizer
13. Soxhlet type continuous extractor
14. Equipment for processing the by-products

RAW MATERIAL

The raw-materials required are :

1. Shark liver
2. Chemicals

PRE-CONSTRUCTION COST ESTIMATION

(To process 1/4 ton shark liver oil per day)

I. Capital Expenditure

A. *Equipment*

		No.	Rs.	Rs.
1.	Cold rooms— 12′ × 12′ × 8′ (—4° C to 10° C) 12′ × 12′ × 8′ (15°C)	2	15,000/-	
.2	Liver chopper-500 lbs. per hour	1	6,000/-	
3.	Steam jacketted cooking pans, 200 lbs. each	3	4,000/-	
4.	Sharples centrifuge (moveable type)	1	20,000/-	
5.	Alkaline treatment vats, 50 lbs. each	3	6,000/-	
6.	Steam distillation apparatus, 20 lit. cap.	3	21,000/-	
7.	Crude oil electric generator 5 K. W.	1	15,000/-	
8.	Overhead tanks with pump and stainless steel piping		6,000/-	
9.	Boiler 65 lbs. pressure, maximum 400 lbs. per hour	1	28,000/-	
10.	Capsulating machine	1	5,000/-	
11.	Spectrophotometer and other testing and standardization equipment		18,000/-	
12.	Homogenizer, 25 lbs. per hour		16,000/-	
13.	Soxhlet type, liquid-liquid continuous extractor		15,000/-	
14.	Equipment for processing the by-products		5,000/-	
				1,80,000/-

B. *Building*

		Rupees	Rupees
1. Plant 100′ × 40′ × 15′	at		
2. Office & Laboratory 20′ × 16′ × 15′	Rs. 12/- per sq. ft.	57,120/-	
3. Boiler room 10′ × 12′			
4. Furniture		5,000/-	
5. Sanitary and electrical fittings, plumbing etc.		30,000/-	
			92,120/-
Total capital expenditure			2,72,120/-

II. Running Expenditure

A. 1. *Raw Materials*

	Rupees per annum
Shark liver 168,000 lbs.	48,000/-

2. *Chemicals*

(*a*) "C. S."	800/-
(*b*) "A. 95%"	1,125/-
(*c*) "E"	5,000/-
(*d*) "A. S. S"	300/-
(*e*) "S. L."	1,000/-
(*f*) "G. T."	420/-
(*g*) "C. C."	600/-
(*h*) "N"	400/-
3. *Fuel Oil*	6,000/-
	63,645/-
For three months,	15,940/-

B. *Direct Labour*

	Rupees per mensum	*Rupees per annum*
1. Chemist	600/-	7,200/-
2. Lab. Asstt.	200/-	2,400/-
3. Foreman	300/-	3,600/-
4. Mechanic	200/-	2,400/-

	Rupees per mensum	*Rupees per annum*	Rupees
5. Operators (4)	150/-	7,200/-	
6. Store-keeper	175/-	2,100/-	
7. Boiler attendant	175/-	2,100/-	
8. Packers (4)	100/-	4,800/-	
		31,800/-	
For three months			7,950/-

C. *Indirect Labour (Establishment)*

	Rupees per mensem	*Rupees per annum*	
1. Works Manager	750/-	9,000/-	
2. Accountant	250/-	3,000/-	
3. Steno-typist	150/-	1,800/-	
4. Accounts Clerk	125/-	1,500/-	
5. Peons (2)	60/-	1,440/-	
6. Chowkidars (3)	60/-	2,160/-	
7. Sweeper	60/-	720/-	
8. Liver Buyer	250/-	3,000/-	
		22,620/-	
For three months,			5,655/-

D. *Selling Expenses*

	Rupees	
1. Sales Representatives (2) Rs. 200/- p.m.	4,800/-	
2. T. A. for above Rs. 100/- p.m. per head	2,400/-	
	6,200/-	
For three months,		1,800/-

E. *Miscellaneous*

1. Packages, glass containers and cardboard boxes	50,000/-	
2. Power 35 K.W. hours daily	10,500/-	
3. Office Expenses	5,000/-	
4. Interest on capital at 4% on Rs. 3,30,000/-	13,200/-	
5. Contingencies	5,000/-	
6. Maintenance (3% on total capital)	9,600/-	
Rs.	1,03,300/-	

	Rupees	Rupees
For three months		25,825/-
Total running expenditure		57,170/-
Total capital expenditure		2,72,120/-
Total capital investment		3,29,290/-
Say,		3,30,000/-

1. DIRECT EXPENSES

Raw materials	63,645/-	
Direct wages	31,800/-	
Containers	50,000/-	
Power	10,500/-	
Contingencies	5,000/-	
Maintenance	9,600/-	
Depreciation at 10%	27,212/-	
		1,97,757/-

2. INDIRECT EXPENSES

Establishment	22,620/-	
Promotion of the project, at $2\frac{1}{2}$% on Rs. 3,30,000/-	8,250/-	30,870/-
3. SELLING EXPENSES		7,200/-
4. INTEREST ON CAPITAL at 4% on Rs. 3,30,000/-		13,200/-
5. INSURANCE at 2% on Rs. 3,35,800/-		8,395/-
Cost production of 33,600 lbs. of crude Shark liver oil inclusive of processing expenses for the finished products		2,57,442/-

NON-TECHNICAL NOTE

ON

PRINTING AND OTHER OIL-BASED INKS

Printing and other oil-based inks are mainly composed of a pigment material and a vehicle, usually a drying oil, in which the pigment is distributed in a finely divided state. But to prepare a stable composition of the proper consistency, adhesion flow, colour and brilliancy involves a specialised technique and rigid control of the process and formulation. The introduction of automatic printing machine demands still greater perfection and uniformity in ink composition. The manufacture of ink is, therefore, a highly developed art, but on account of its large and universal demand, good quality printing and other inks are produced in almost all advanced countries. Pakistan, however, does not have a well established ink manufacturing industry, with the result that almost all types of printing and other inks required in the country are being imported. Investigations were, therefore, taken up in the Central Laboratories of the Council of Scientific and Industrial Research and various types of oil-based-inks, such as Stamp cancelling, Duplicating and News Inks. As a result of these investigations it has been possible to evolve various compositions for these inks, which dry mainly by absorption. They are almost exclusively based on indigenous raw materials and compare favourable with the best quality imported inks of each of these categories.

The estimated demand of the various kinds of inks based on the figures of import is as given below:-

1.	Postal ink	10,000	lbs.	approx.
2.	Duplicating ink	50,000	..	.. ..
3.	News printing ink	100,000	..	.. ..

A unit with a production capacity of the above indicated quantities of inks is estimated to require the total capital investment of about Rs. 2,00,000/-

The average cost of the ink in a unit of this size would be about Rs. 1/2/- inclusive of overhead expenses, as compared to the prevailing market price of these inks indicated below:-

1.	Postal ink	Rs. 4/-/-	to	5/-/-	per	lb.
2.	Duplicating ink	Rs. 9/-/-	to	10/-/-	per	lb.
3.	News ink	Rs. 4/-/-	to	8/-/-	per	lb.

PROCESS

The process consists essentially of preparing a stabilising varnish which is thoroughly mixed with other ingredients, the whole mass being then passed through a roller mill.

EQUIPMENT

The equipment required is:—

1. Edge runner
2. Mixer
3. Single and triple roll mills
4. Straining and sieving machine
5. Filling machines
6. Storage tanks, pumps, electric motors, laboratory testing equipment, etc.

All of these have to be imported from abroad.

RAW MATERIALS

1. Rosin
2. Oil (vegetable and mineral oils)
3. Pigment
4. Chemicals

All the raw materials are available in the country, except carbon-black which represents only about 6.5% of the total value.

PRE-CONSTRUCTION COST ESTIMATION

PRODUCTION CAPACITY:—

News Ink	1,00,000	lbs./annum
Duplicating Ink	50,000	lbs./annum
Stamp cancelling Ink	10,000	lbs./annum

I. CAPITAL EXPENDITURE

A. *Equipment*

1. Edge runner mill 3′ dia. Belt driven with fast & loose pully	No. 1	Rs. 20,000/-	Rs.

		No.	Rupees	Rupees
2.	Triple roll mill 24′×12′, fitted with chilled iron rolls with water cooling attachment	1	35,000/-	
3.	Muster uniroll mill	1	15,000/-	
4	Planetory mixer 40 gals. cap.	1	9,000/-	
5	High speed mixer	1	3,000/-	
6	Automatic filling machine	1	5,000/-	
7	Tube filling machine	1	3,000/-	
8	Storage tanks	5	1,000/-	
9	Varnish kettle 50 gals. cap.	1	1,000/-	
10	Centrifuge	1	5,000/-	
11	Laboratory testing equipment		10,000/-	
12	Miscellaneous		10,000/-	
				1,17,000/-
B.	*Building*			
1	Processing Hall 30′×60′	1800	sq. ft.	
2	Storage-raw material 15′×20′	300	.. ..	
3	Storage-finished goods 15′×20′	300	.. ..	
4	Office-Works Manager 12′×20′	240	.. ..	
5	Office-general 2×12′×20′	480	.. ..	
		3120	.. ..	
	Cost at Rs. 10/- per sq. ft.		31,200/-	
	Sanitary and electrical fittings plumbing, furniture, etc.		10,000/-	
				41,200/-
	Total capital expenditure			1,58,200/-
	Say			Rs. 1,60,000/-

II. RUNNING EXPENDITURE

	Rupees	Rupees
A. *Raw Materials*		
1. For 1,00,000 lbs. per year of newsprint ink:— Pigment, 8000 lbs. @ Rs. 1/- per lb.	*Rs.* 8,000/-	
For six months		4,000/-
Vehicle 82,000 lbs. @ Rs. -/5/- per lb.	25,625/-	
Stabilizer 10,000 lbs. @ Rs. -/8/- per lb.	5,000/-	
	Rs. 30,625/-	
For three months		7,657/-
2. For 50,000 lbs. per year of duplicating ink:— Pigment 2,750 lbs. @ Rs. 1/- per lb.	Rs. 2,750/-	
For six months		1,375/-
Vehicle 19,750 lbs. @ Rs. -/5/- per lb.	6,172/-	
Stabilizer, 5000 lbs. @ Rs. -/8/- per lb.	2,500/-	
Emulsion Stabilizer 1500 lbs. @ Rs. 3/- per lb.	4,500/-	
	Rs. 13,172/-	
For three months		3,293/-
3. For 10,000 lbs. per year of stamp cancelling ink:— Pigment 600 lbs. @ Rs. 1/- per lb.	*Rs.* 600/-	
For six months		300/-
Stabilizer 1000 lbs. @ Rs. -/8/- per lb.	500/-	
Vehicle 8400 lbs. @ Rs. -/5/- per lb.	2,525/-	
	Rs. 3,125/-	
For three months		786/-
		Rs. 17,411/-

B *Direct Labour*

	Rupees per mensem	Rupees per annum	Rupees
Asstt. Chemist	280/-	3,360/-	
Mechanic	120/-	1,440/-	
Operators (3)	120/-	4,320/-	
Lab. Attendant	85/-	1,020/-	
Labourers (4)	85/-	4,080/-	
		14,220/-	
For three months			3,555/-

C *Indirect Labour (Establishment)*

	Rupees per mensem	Rupees per annum	
Works Manager	800/-	9,600/-	
Accountant	250/-	3,000/-	
Clerks (2)	115/-	2,760/-	
Stenotypist	135/-	1,620/-	
Store-keeper	140/-	1,680/-	
Peons (2)	75/-	1,800/-	
Chowkidars	60/-	1,440/-	
		21,900/-	
For three months			5,475/-

D *Selling Expenses*

Sales Representative Rs. 350/- p.m.	4,200/-	
For three months		1,050/-

E *Miscellaneous*

	Rupees	
Packages:—50,000 collapsible tubes @ Rs. 500/- per 1000	25,000/-	
tins and drums	15,000/-	
Power	3,000/-	
Office expenses	8,000/-	
Interest on capital @ 4% on Rs. 2 lacs	8,000/-	
Contingencies	5,000/-	
	64,000/-	
For three months		16,000/-
Total running expenditure		43,491/-
Total capital expenditure		1,60,000/-
Total capital investment		Rs. 2,03,491/-

		Rupees per annum	*Rupees*
1.	DIRECT EXPENSES		
	Raw material	59,000/-	
	Direct wages	14,220/-	
	Containers	40,000/-	
	Power	3,000/-	
	Contingencies	5,000/-	
	Depreciation @ 10%	16,000/-	
			1,37,220/-
2.	INDIRECT EXPENSES		
		Rupees	
	Establishment	21,900/-	
	Promotion of the project @ 2½% on Rs. 2,00,000/-	5,000/-	
			26,900/-
3.	SELLING EXPENSES		4,200/-
4.	INTEREST ON CAPITAL @ 4% on Rs. 2 lacs		8,000/-
5.	INSURANCE @ 2½% on Rs. 2,19,000/-		5,475/-
	Total cost of production of 1,60,000 lbs. of inks		1,81,795/-
	Average cost of ink		Rs. 1/2/- per lb.

NON-TECHNICAL NOTE
ON
FOUNTAIN PEN INKS

The making of writing ink is a very ancient art. The earliest inks consisted of lamp black ground with glue and moulded into sticks which were mixed with water before use. Such inks were used in the early Egyptian and Chinese civilizations as early as 2500 B. C. There are references to Iron-gallo inks-solutions of an iron salt, usually ferrous sulphate, in extracts of tannin bearing materials dating back to 210 B. C. Prior to the modern era of wide spread manufacture and distribution of goods, the making of writing ink was a household art. The present day writing ink industry, although very old, is relatively small and highly competitive, and the exact composition of the product is the individual manufacturer's secret.

The present annual consumption of fountain pen ink, in Pakistan, which has an upward trend, is estimated at 30,000 gal., valued at about Rs. 10,00,000/- of which about 50% is imported.

The locally produced inks are, however, of a very poor quality, necessitating the continued import of high quality inks from abroad. The ink produced according to a process developed in the Council's Laboratories after patient, systematic studies has been found, after a series of rigorous tests, to be comparable with the best imported brands.

The total capital investment for a production unit with a capacity of 7000 gallons per year is estimated at Rs. 100,000/- and the average cost of 2 fluid oz. bottle of ink would be Rs. -/4/- as againt Rs. 1/-/- for a similar quality of imported ink.

PROCESS

The unit processes involved are:—

1. Preparation of distilled water
2. Preparation of the various solutions
3. Mixing of the solutions
4. Ageing of the ink
5. Centrifuging
6. Filling the bottles
7. Capping the bottles
8. Labelling
9. Packing

EQUIPMENT

The equipment required consists of:—

1 Water distillation plant
2 Agitators
3 Mixers
4 Filters
5 Centrifugal separating machine
6 Mixing tank
7 Air - tight storage tanks
8 Filling machine
9 Bottle capping machine
10 Bottle washing machine
11 Labelling machine
12 Packing machine

The last four machines are not very essential and can be dispensed with.

RAW MATERIALS

The raw materials required are:—

1. Dyes
2. Acids
3. Some chemicals

PRE-CONSTRUCTION COST ESTIMATION

(Production capacity 7000 gallons per day)

I. Capital Expenditure

A. *Equipment*

		No.	Rs.	Rs.
1.	Water distillation plant, 10 gals. cap.	1	1,500/-	
2.	Maxing tank with stirrer 10 gals. cap.	2	5,000/-	
3.	Filter	1	5,000/-	
4.	Centrifugal separating machine	5	1,000/-	
5.	Air-tight storage tanks	15	7,500/-	
6.	Filling machine	1	3,000/-	
7.	Contingencies		5,000/-	
				28,000/-

B. *Building*		Rupees	Rupees
1.	2160 sq. ft. @ Rs. 10/- per sq. ft.	21,600/-	
2.	Sanitary and electrical fittings, plumbing, furniture, etc.	5,000/-	26,600/-
	Total capital expenditure		54,600/-

II. RUNNING EXPENDITURE

A. *Raw Materials*

		lbs. per year	Rupees	
1.	"F. S."	560	4,200/-	
2.	"G. A."	210	4,725/-	
3.	"T. A."	350	6,475/-	
4.	"P. G. A."	420	36,960/-	
5.	"H. A."	185.4	1,742/-	
6.	"P".	70	1,000/-	
7.	"Dye"	350	20,000/-	
8.	"I. P. A."	1365	5,000/-	
	Total			80,102/-
	For six months			40,051/-

B. *Direct Labour*		*Rupees per mensem*	*Rupees per annum*	Rupees
1.	Semi-skilled hands (6)	80/-	5,560/-	
2.	Chemist	350/-	4,200/-	
				9,960/-
	For six months			4,980/-

C. *Indirect Labour* (*Establishment*)

		Rupees per mensem	*Rupees per annum*	
1.	Executive Officer	350/-	4,200/-	
2.	Clerks (2)	120/-	2,880/-	
3.	Peons (2)	60/-	1,440/-	
4.	Chowkidars (3)	60/-	2,160/-	
5.	Accounts Clerk	150/-	1,800/-	
				12,480/-
	For six months			6,240/-

D. *Selling Expenses*	Rupees	Rupees
1. Sales representatives (2) Rs. 150/- p.m.	3,600/-	
2. T. A. to sales representatives Rs. 150 p.m. per head	1,200/-	
	Rs. 4,800/-	
For six months		2,400/-

E. *Miscellaneous*

	Rupees
Packages	10,000/-
Power	6,000/-
Office expenses	5,000/-
Interest on capital @ 4% on Rs. 1 lac	4,000/-
Contingencies	5,000/-
	30,000/-
For six months	15,000/-
Total running expenditure	42,920/-
Total capital expenditure	54,600/-
Total capital investment	97,520/-
Say,	1,00,000/-

1. RUNNING EXPENSES

	Rupees	
Raw materials	80,000/-	
Direct wages	9,960/-	
Containers	10,000/-	
Power	6,000/-	
Contingencies	5,000/-	
Depreciation @ 10%	5,460/-	
		1,16,420/-

2. INDIRECT EXPENSES

	Rupees	
Establishment	12,480/-	
Promotion of the project @ 2½% on 1 lac	2,500/-	
		14,980/-

		Rupees
3.	Selling Expenses	4,000/-
4.	Interest on Capital @ 4% Rs. 1 lac	4,000/-
5.	Insurance @ $2\frac{1}{2}$% on Rs. 82,200/-	2,055/-
	Cost of production of 7000 gals. of ink.	1,42,255/-

Average cost of ink Rs. 20/- per gal.

NON-TECHNICAL NOTE

ON

HEAT AND SOUND INSULATION BOARDS FROM SUGAR CANE BAGASSE AND OTHER AGRICULTURAL WASTES

Sugar-cane bagasse, reeds, coconut fibre, rice husks and similar other materials find little economic use and are wasted in considerable quantities. For instance, bagasse which is a by-product in the process of cane crushing is mainly used as a cheap fuel for boilers in sugar-cane factories, but even after meeting the requirements of fuel large quantities are left over as surplus for which there is paractically no use.

With a view to utilise these materials, investigations were undertaken in the Laboratories of the Council of Scientific & Industrial Research, and it has been possible to evolve a commercially feasible proccess for the manufacture of low-cost heat and sound insulation boards which can be used in buildings for partitions, false ceiling, etc. These boards have a thermal conductivity of 0.09 (same as glass wool), 1 inch thickness of the board being roughly equivalent to 10 inches of brick work in respect of insulation, and a tensile strength of 90 lbs. per sq. inch. These boards can aslo be used on light weight roofs in a sandwich system of water proof material. On account of the light weight of the roof, made of sandwiched boards, the supporting structure and the load-bearing walls need not be as strong as would be necessary for any other normal type of roof, thus resulting in a considerable amount of saving in the overall construction cost.

The total capital investment for a unit producing annualy 60,000 boards of $8' \times 4' \times 1'$ thick is estimated at approximately Rs. 5,25,000/-. The average cost per sq. ft. of the board in a unit of this size is estimated at Rs. -/2/6. The present market price of similar board is Rs. -/8/- to Rs. -/10/- per sq. ft.

PROCESS

The process of manufacturing these boards consists of the following unit operations:—

1 Shredding
2 Cooking
3 Mixing and beating
4 Pressing in moulds
5 Drying

The process is simple, requiring very little specialised knowledge or technical know-how, and can be carried out by semi-skilled labour with limited overall technological supervision.

EQUIPMENT

The basic equipment required consists of:—

1 Shredder
2 Pressure Cooker
3 Beater
4 Hydraulic Press
5 Drying Chamber

With the exception of last item which can be constructed locally, the other items of the equipment will have to be imported.

RAW MATERIALS

The raw materials required in the process are:—

1 Bagasse
2 Reeds
3 Coconut fibre
4 Chemicals

All these materials are easily available in the country.

PRE-CONSTRUCTION COST ESTIMATION

(Production capacity-60,000 boards 8′×4′×1′ per year)

I. CAPITAL EXPENDITURE

A. *Equipment*

	Description	Quantity	Price Rs.
1.	Shredder	1	20,000/-
2.	Pressure Cooker (8′ dia. × 10′)	1	1,00,000/-
3.	Beater (Hollander) 1000 lbs. cap.	2	1,00,000/-
4.	Hydraulic Press (8′×4′)	2	40,000/-
5.	Drying Chamber 80° C.	1	20,000/-
6.	Boiler (60 lbs. steam 1000 lbs. P.H.)	1	50,000/-
	Miscellaneous		20,000/-
	Total for equipment		3,50,000/-

B. *Building*

Plant	5000	sq. ft.
Storage	2000	sq. ft.
Manager's office 12′×14′	168	sq. ft.
General office 20′×12′	240	sq. ft.
Labs. etc. 20′×12′	240	sq. ft.
	7648	sq. ft. @ Rs. 10/- per sq. ft.

Say	Rs. 77,000/-
Sanitary and electrical fittings, plumbing, furniture etc.	Rs. 30,000/-
	Rs. 1,07,000/-

Total for equipment	Rs. 3,50,000/-
Total for building	Rs. 1,07,000/-
Total capital expenditure	Rs. 4,57,000/-

II. RUNNING EXPENDITURE

A. *Raw Materials*

	Rupees	Rupees
1. Shredded material 34,10,000 lbs. per year Rs. 1/8/- per maund	63,938/-	
2. Chemicals 2,08,800 lbs. per year	36,540/-	
		1,00,478/-
Say,		1,01,000/-
For three months		25,250/-

B. *Direct Labour*

	Rupees per mensem	*Rupees Per annum*	
Engineer	500/-	6,000/-	
Chemist	350/-	4,200/-	
Operators (7) per shift	150/-	37,000/-	
			47,200/-
For three months			12,000/-

C. *Indirect Labour (Establishment)*

		Rupees Per mensem	*Rupees Per annum*	
Works Manager		750/-	9,000/-	
Clerks	(2)	115/-	2,760/-	
Accountant		250/-	3,000/-	
Peons	(2)	60/-	1,440/-	
Chowkidars	(3)	60/-	2,160/-	
			18,360/-	
For three months				4,590/-

D. *Selling Expenses*

	Rupees per mensem	*Rupees per annum*	
Asst. Manager (Sales)	450/-	5,400/-	
Sales Representatives (2)	200/-	4,800/-	
Travelling allowances for the Sales Representatives Rs. 100/- p.m. per head		2,400/-	
		12,600/-	
For three months			3,250/-

E. *Miscellaneous*

	Rupees	Rupees
Power	15,000/-	
Office expenses	5,000/-	
Interest on capital @ 4% on 5¼ lakhs	21,000/-	
Contingencies	6,000/-	
	47,000/-	
For three months		11,750/-
Total running expenditure		56,740/-
Total capital expenditure		4,57,000/-
Total capital Investment		5,13,740/-
Say,		5,25,000/-

1. DIRECT EXPENSES

	Rupees	
Raw materials	1,01,000/-	
Direct wages	48,000/-	
Power	15,000/-	
Contingencies	6,000/-	
Depreciation @ 10%	45,700/-	
		2,15,700/-

2. INDIRECT EXPENSES

	Rupees	
Establishment	18,360/-	
Promotion of the project @ 2½% on 5¼ lakhs	13,125/-	
		31,485/-

3. SELLING EXPENSES 12,600/-

4. INTEREST ON CAPITAL @ 4% on Rs. 5¼ lakhs 21,000/-

5. INSURANCE @ 2½% on Rs. 5, 58,000/- 13,950/-

Total cost of production for 60,000 boards 2,94,735/-

Cost per board 8′×4′ Rs. 4-14-7, say Rs. 5-0-0

Cost per sq. ft. Rs. 0-2-6

NON-TECHNICAL NOTE ON

"FIXEMPER"

Alkali-free Distemper

An entirely new type of alkali free composition for "dry distemper" has been developed by the Central Laboratories, Pakistan Council of Scientific and Industrial Research, Karachi and is based almost entirely on indigenous materials. This distemper is most suited for application to cement, concrete and cement products generally either for interior or exterior use and if properly used will give a fairly high degree of durability. For application on fresh concrete surface, a coating of C.S.I.R's **Distemper Priming** is recommended. Alternatively the surface may be given a lime wash and distemper applied after 15 days.

Application :

New concrete should not generally be painted until it has dried at the surface: the time necessary for this will vary according to weather conditions and other circumstances, but should not be less than 24 days in case. The surface to be painted should be brushed to remove loose dust and if moderately contaminated by dirt, should be scrubbed using clean water only; soap or soda should not be used.

$\frac{3}{4}$ to 1 pint of water are required for 1 lb. of distemper. The dry distemper should be reduced to a stiff paste with about one-third of the estimated amount of water, after which water should be gradually added and the paste stirred until the cream like consistency is attained. Small additions of water may be necessary during use and the mixed paint should be stirred frequently to avoid settling.

Properties :

One lb. of C.S.I.R. distemper will cover 70-80 sq.ft. The surface becomes rub-proof within two hours after application as compared to 24 hours required for normal distemper work.

The distemper gives a water-proof finish and is suitable for out door use as well. Because of alkali free composition the colours do not fade on ageing.

PRE-CONSTRUCTION CAST ESTIMATION

Annual Production 300 Tons/yr.

I. Capital Expenditure

A. *Equipment*

		Rupees
1.	Furnace	8,000.00
2.	Grinding mill	10,000.00
3.	Ball mill	20,000.00
4.	Laboratory & Miscellaneous	7,000.00
		45,000.00

B. *Buildings*

1.	Shed	300	sq. ft.	
2.	Processing hall	600	sq. ft.	
3.	Store raw material	400	sq. ft.	
4.	Store finished product	500	sq. ft.	
5.	Office	500	sq. ft.	
		2,300	sq. ft.	Rs. 41,400.00

II Running Expenditure

A. *Raw Materials*

	Rupees
No. 1	4,500.00
No. 2	4,800.00
No. 3	42,000.00
No. 4	20,000.00
No. 5	1,500.00
	Rs. 72,800.00

B. *Direct Labour*

		Rupees per mensem	Rupees
1.	Chemist	300.00	3,600.00
2.	Operators (2)	100.00	2,400.00
3.	Labours (8)	75.00	7,200.00
			Rs. 13,200.00

C. *Indirect Labour (Establishment)*

		Rupees per mensem	Rupees
1.	Manager	500.00	6,000.00
2.	Accountant	400.00	4,800.00
3.	Clerks (2)	150.00	3,600.00
4.	Peons (2)	75.00	1,800.00
			Rs. 16,200.00

D. *Selling Expenses*

	Rupees per mensem	Rupees
Salesman (2)	300.00	7,200.00

E. Miscellaneous

Packages	25,000.00
Fuel	1,600.00
Power	3,000.00
Office expenses	1,000.00
Contingencies	1,000.00
	Rs. 31,000.00

COSTING

		Rupees per annum
1.	DIRECT EXPENSES	
	Raw materials	72,800.00
	Direct wages	13,200.00
	Miscellaneous	31,600.00
	Depreciation (10%)	4,500.00
2.	INDIRECT EXPENSES	
	Establishment	16,200.00
	Promotion of Project at 5% on Rs. 1,30,000	6,500.00
3.	SELLING EXPENSES	7,200.00
4.	INTEREST ON CAPITAL at 4% on Rs. 1,30,000	5,200.00
5.	INSURANCE at 2½% on Rs. 1,00,000	2,500.00
	Cost per ton	530.00
	Cost per lb.	00.24
	Total running expenditure	40,000.00
	Total capital expenditure	86,400.00
	Total capital investment	1,26,400.00
	Say	1,30,000.00

NON-TECHNICAL NOTE
ON
"CUPREX"
Wood Preservative

The modern wood preservation industry may be said to have started with experiments carried out in the late eighteenth and early nineteenth century in England to protect wooden warships from decay. Shortly afterwards the development of railways created a demand for durable wooden ties. Treatment plants were gradually established throughout Europe and as the advantage of treatment become widely known, mine tempers, telephone and telegraph poles, marine piling, and generally wood intended for use in conditions favouring decay have been treated in increasing quantities. During recent years structural timbers have formed a larger percentage of the total wooden material treated.

Which is the best wood preservative? No doubt this question has been asked thousands of times. The simple fact is that there is no answer, because there is no *'best'* wood preservative. Some preservatives excel for one purpose and others for other purposes. Nor is there any 'best' method of applying wood preservatives. Pressure treatment is best under certain conditions, and brushing, dipping, soaking, hot-and-cold bath or some other treatment may be preferable and more economical under other conditions. It is perhaps not surprising to find that the wood preservatives most used today have been known for many years. Copper napthenate is classified amongst 7 or 8 standard wood preservatives. Even though it was suggested for wood impregnation, as far back as 1889, it was only during the last world war that huge quantities of copper napthenate was used for treatment of timber. A substitute for copper napthenate "Cuprex" based on indigenous materials has been developed at the Central Laboratories, Pakistan Council of Scientific & Industrial Research, Karachi. Since the total cost of a treated stick of wood includes, among other items, the cost of transportation to and from the treating plant, labour depreciation costs at the plant, and subsequent installation, the cost of the preservative used is only a small percentage of the total cost. The main advantages of "Cuprex' is that it gives satisfactory results by 'cold soaking' or 'dipping method' and its use therefore offers more advantages in this country. The efficiency of Cuprex compares with copper napthenate.

PRE-CONSTRUCTION COST ESTIMATION

(1,50,000 lbs./year)

I. Capital Expenditure

A. *Equipment*

		Rupees
1.	Distillation Kettle	12,000.00
2.	Reaction Kettle	12,000.00
3.	Tank, 200 gallons	500.00
4.	Tanks, 400 gallons (2)	2,000.00
5.	Miscellaneous and Laboratory	8,500.00
	Rs.	35,000.00

B. *Building*

			Rupees
1	Covered shed	500 sq. ft.	
2.	Processing hall	800 sq. ft.	
3.	Filling hall	600 sq. ft.	
4.	Stores-raw materials	500 sq. ft.	
5.	Stores-finished goods	500 sq. ft.	
6.	Office	1,000 sq. ft.	
		3,900 sq. ft.	
	Say	4,000 sq. ft.	80,000.00
		Rs.	1,15,000.00

II. Running Expenditure

A. *Raw Materials*	*Quantity*	*Price/lb.*	*Total Cost in Rupees*
No. 1.	1,30,000 lbs.	0.75	97,500.00
No. 2.	13,000 lbs.	1.12	14,560.00
No. 3.	6,000 lbs.	3.00	18,000.00
No. 4.	10,000 lbs.	1.00	10,000.00
		Rs.	1,40,060.00

B. *Direct Labour*

		Rupees per mensem	Rupees
Chemist		600/-	7,200.00
Operators	(4)	150/-	7,200.00
Labourers	(12)	75/-	10,800.00
Mechanics	(2)	200/-	4,800.00
		Rs.	30,000.00

C. *Indirect Labour (Establishment)*

		Rupees per mensem	Rupees
Manager		800/-	9,600.00
Sales Manager		500/-	6,000.00
Stenographer		400/-	4,800.00
Accountant		500/-	6,000.00
Clerks	(4)	150/-	7,200.00
Peons	(3)	75/-	2,700.00
		Rs.	36,300.00

D. *Miscellaneous*

		Rupees
Packing drums	300 (45 gallons barrel)	15,000.00
Power		1,200.00
Fuel		1,600.00
Office expenses		2,000.00
Miscellaneous & Sundries		5,000.00
	Rs.	24,800.00

	Rupees
Total running expenditure	2,32,000.00
Running expenditure for 3 months	58,000.00
Say	60,000.00
Capital expenditure	1,15,000.00
Running expenditure	60,000.00
Total capital investment	1,75,000.00
Say	Rs. 2,00,000.00

COSTING

		Rupees
1.	Raw materials	1,41,000.00
2.	Direct labour	30,000.00
3.	Indirect labour (establishment)	36,300.00
4.	Miscellaneous expenses	24,800.00
5.	Depreciation (20% of 60,000)	12,000.00
6.	Sales promotion (5% on Rs. 2,00,000)	10,000.00
7.	Insurance (3% on Rs. 1,50,000)	4,500.00
	Total cost for 1,50,000 lbs.	Rs. 2,58,600.00
	Cost per lb.	Rs. 1.75

NON-TECHNICAL NOTE

ON

WOOD CHIP BOARD

The manufacture of chip boards started about 20 years ago in Germany during the War with the main object of utilising the waste material of wood working. Since then this industry has been expanding to the extent that chip boards occupy an unique place in wood working industries. The chip boards are useful for high-class furniture, specialised jobs and interior par ition walls and have following advantages:—

1. They have a pleasing appearance.
2. They have dimensional stability.
3. They have a good thermal insulation.
4. They have good accoustical properties.
5. They have fine resistance.
6. They are resistant to insect attack.

In view of the shortage of wood in our country, the problem of the utilisation of local wood waste is of vital importance and therefore necessary investigations were carried out at the Central Laboratories, Pakistan Council of Scientific and Industrial Research, Karachi to devise a process for the production of chip boards. During the investigations a new composition for the binder based on a carbohydrate modified phenolic resin was developed. The cost of production of the chip boards according to process developed by PCSIR works out approximately as follows:—

Thickness	Price per sq. ft.
$\frac{1}{2}''$	0.50 Paisas
$1''$	0.74 Paisas
$\frac{1}{4}''$	0.28 Paisas
$\frac{1}{8}''$	0.19 Paisas

The comparative market prices of similar products are as follows:—

Ply wood (Pakistani)	1.24	per sq. ft.
Ply wood (Pak. Teak Wood)	1.00	,,
Ply wood (China)	0.69	,,
Hard board (Swedish)	0.41	,,

I. CAPITAL EXPENDITURE

		Rupees
(1)	Machines & equipment	600,000.00
(2)	Installation& electric installation	25,000.00
(3)	Buildings	1, 25,000.00
		Rs. 2,50,000.00

II. RUNNING EXPENDITURE

(1) *Indirect Labour*

General & Works	*Rupees per mensem*	Rupees
Manager	1,500.00	18,000.00
Accountant	600.00	7200.00
Clerks (4)	200.00	9600.00
Stenographer	400.00	4800.00
Store Keeper	250.00	3000.00
Asst: Store Keeper	150.00	1800.00
Peons (2)	80.00	1920.00
Chowkidars (4)	75.00	3600.00
		49,920.00
Say		Rs. 50,000.00

(2) *Direct Labour*

	Rupees per mensem	Rupees
Mechanical Engineer	1,000.00	12,000.00
Chemist	500.00	6,000.00
Asst: Chemist	250.00	3,000.00
Mechanics (3)	300.00	10,800.00
Operators (18)	150.00	32,400.00
Labourers (12)	100.00	14,400.00
		78,600.00
Say		79,000.00
(3) Power		15,000.00
(4) Fuel expenses		10,000.00
(5) Office expenses		10,000.00
(6) Contingencies		10,000.00
(7) Insurance & Miscellaneous		10,000.00
(8) Depreciation at 20%		1,50,000.00
Total	Rs.	2,05,000.00
Say	Rs.	3,40,000.00
Production cost excluding raw material cost per day:—	Rs.	950.00

(A) **Cost of Chipboards of $\frac{1}{2}$" thickness**

Capacity 12 cu. ft. / hr. $\times$ 24 = 288 say 250 cu. ft. / day

Item	**Price**	**Rupees**
Wood 280 mds.	2.00 / md.	560.00
Binder 2000 lbs.	0.75 / lbs.	1,500.00
Production expenses	700.00 / day	950.00
	Rs.	3,010.00
Production cost per cu. ft.		Rs. 12.00
Production cost per sq. ft.		Rs. 0.50

(B) **Cost of Chipboards of 1″ thickness**

Capacity 19 cu. ft. / hr. × 24 = 456 say 400 cu. ft. / day

Item	Price	Rupees
Wood 350 mds.	2.00 / md.	700.00
Binder 2500 lbs.	0.75 / lb.	1875.00
Production expenses		950.00
		Rs. 3525.00
Production cost per cu. ft.		Rs. 8.81
Production cost per sq. ft.		Rs. 0.74

(C) **Cost of Chipboards of $\frac{1}{4}$″ thickness**

Capacity 8 cu. ft. / hr. × 24 = 192 cu. ft. say 170 cu. ft.

Item	**Price**	**Rupees**
Wood 165 mds.	2.00 / md.	330.00
Binder 1350 lbs.	0.75 / lb.	1012.50
Production expenses		950.00
		Rs. 2292.50
Production cost per cu. ft.		Rs. 13.50
Production cost per sq. ft.		Rs. 0.28

(D) **Cost of Chipboards of $\frac{1}{8}$″ thickness**

Capacity 4 × 24 = 96 cu. ft. say 80 cu. ft.

Item	Price	Rupees
Wood 70 mds.	2.00 / md.	140.00
Binder 550 lbs.	0.75 / lb.	412.50
Production expenses		950.00
		Rs. 1502.50
Production cost per cu. ft.		Rs. 18.40
Production cost per sq. ft.		Rs. 0.19

NON-TECHNICAL NOTE

ON

DRIED SLAUGHTER HOUSE BLOOD

Pakistan produces annually about 25,000 tons of animal blood which, if properly dried and exported, can bring about 25 lakhs of rupees in foreign exchange.

At the present time arrangements for collecting slaughter house blood, though inadequate, are available only in Karachi, Lahore and Dacca. No arrangements exist in other towns and cities of Pakistan for collecting blood which, therefore, goes waste.

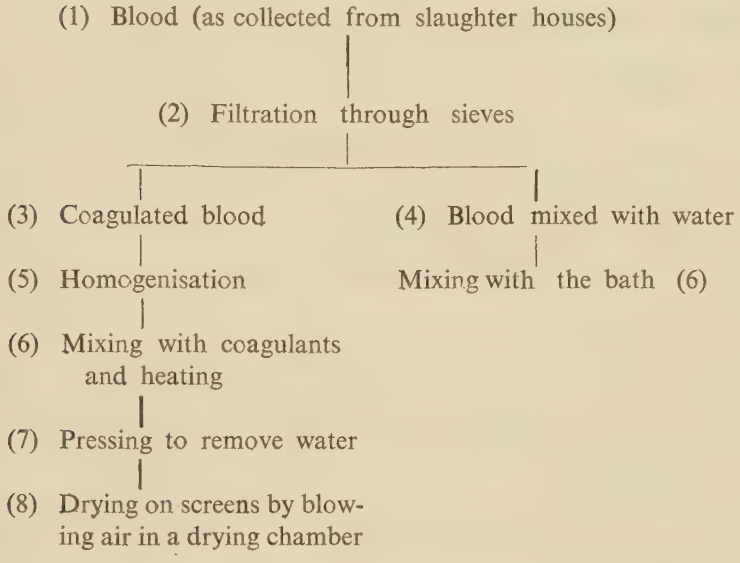
Some people in the three cities mentioned above, collect the blood and try to dry it by primitive method of heating and spreading the coagulated blood in the sun. This method is not only uneconomic but it also created a nuisance of bad odour, flies and very unhygienic condition. In order to overcome these difficulties some times 1% DDT powder is dusted on the coagulated blood to avoid putrefaction. This method of drying takes about two days to dry the blood in summer and four days in winter. It also causes considereable loss of nitrogen due to the decomposition of protiens by microorganisms. During rainy season drying of blood, according to this method, became almost impossible. This results in blood not being collected for a considerable period in the year. Moreover, excessive heating of the blood affects its quality. It was, therefore, considered desirable to develop a simple method for drying blood.

A process has now been evolved in the West Regional Laboratories of the P.C.S.I.R. which obviates all the difficulties enumerated above. The quality of the product prepared, according to this method, is not in any way inferior to that made according to the most modern methods. The method can be employed anywhere in big towns or in small localities.

The total capital investement for a unit with an annual production capacity of 75 tons of dried blood is estimated approximately Rs. 30,000/-

PROCESS

The process follows the flow sheet given below:


(1) Blood (as collected from slaughter houses)
(2) Filtration through sieves
(3) Coagulated blood
(4) Blood mixed with water
(5) Homogenisation
Mixing with the bath (6)
(6) Mixing with coagulants and heating
(7) Pressing to remove water
(8) Drying on screens by blowing air in a drying chamber

EQUIPMENT

The equipment required consists of the following:

1. Drums
2. Sieves
3. Electric stirrers
4. Furnaces
5. Iron pans
6. Screw presses
7. Screen trays
8. Drying tunnel
9. Bags

RAW MATERIAL

The raw materials required are:

1. Blood
2. Coagulant

PRE-CONSTRUCTION COST ESTIMATION

To produce 8 mds. of dry blood daily.

I. Capital Expenditure

A. *Equipment*

		Qty.	Rupees
1.	Round iron pan with perforated bottom capacity 5 mds.	1	210/-/-
2.	Round Iron pans capacity 10 mds.	2	800/-/-
3.	Round iron pan capacity 4 mds.	1	200/-/-
4.	Furnaces with capacity of holding one md. of coal	2	500/-/-
5.	Electric stirrer with 4 blades of 3 sq. inch each	1	400/-/-
6.	Iron pipe of 3″ bore size and 36″ length	1	100/-/-
7.	Screw press for removing water from coagulated blood	2	800/-/-
8.	Electric motors one H.P. each	2	800/-/-
9.	Screen racks 30″ × 60″ for drying	200	4000/-/-
10.	Drying tunnel	1	1100/-/-
11.	Miscellaneous		200/-/-

B. *Building*

1.	Land for the installation of the equipments 18′ × 38′	5000/-/-
2.	Tin sheet coverage for the plant	1000/-/-
3.	Storage room 10′ × 10′ for the storage of 100 mds. of blood	4000/-/-
	Total capital expenditure	Rs. 19110/-/-

II. Running Expenditure

A. 1.	*Raw Material*	*Rupees per annum*	
	Blood	1500/-/-	
2.	*Chemicals*	450/-/-	
		Rs. 1950/-/-	
	For three months,		Rs. 488/-/-

B. *Direct Labour*

	Rupees per mensem	Rupees
Labourers (5)	50/-	3000/-/-
For three months,		750/-/-

C. *Indirect Labour*

1. Typist	100/-	1200/-/-
2. Peon	60/-	720/-/-
3. Sweeper	30/-	360/-/-
Total		Rs. 2280/-/-
For three months,		545/-/-

D. *Selling Expenses*

10% on the running expenditure	1019/-/-

E. *Miscellaneous*

1. Power	Rs. 2½ daily	600/-/-
2. Coal	Rs. 6/-/- daily	1440/-/-
Total		Rs. 2040/-/-
For three months,		Rs. 510/-/-
Total running expenditure		Rs. 10197/-/-
For three months,		Rs. 2520/-/-
Total capital expenditure		Rs. 29307/-/-
Say,		Rs. 30000/-/-

DIRECT EXPENSES

Raw material	1500/-/-
Direct wages	750/-/-
Containers	75/-/-
Power	600/-/-
Coal	1440/-/-
Depreciation 10%	2900/-/-
Transportation	2400/-/-
	Rs. 9665/-/-

INTEREST ON CAPITAL 4% on Rs. 30,000/-/-	Rs. 1200/-/-
INSURANCE 2½% on Rs. 30,000/-/-	Rs. 750/-/-
Cost of production of 75 tons of dried blood inclusive of processing expenses, transportation and depreciation of the plant.	Rs. 15,497/-/-
Say,	Rs. 16,000/-/-
Cost of one maund of dried blood	Rs. 8/-/-
Export price of one maund of dry blood	Rs. 18/-/-
Annual profit	Rs. 20,000/-/-
Percentage of profit	Rs. 125%

In smaller towns where the production of blood is below 15 mds. per day stirring may be achieved by hand.

One of the labourers should know the handling of furnaces.

X

SCIENTIFIC AND INDUSTRIAL LIASION

SCIENTIFIC AND INDUSTRIAL LIAISON

One of the important functions of the Pakistan Council of Scientific and Industrial Research is to provide scientific and industrial liaison on national as well as international levels. Whereas the importance of co-operation between the worker in the same and allied fields is well recognized in science, the necessity of technical liaison between scientific research on industry in this country has not often fully realised: neither is it so readily brought about. The Pakistan Council of Scientific and Industrial Research has therefore taken constructive steps to render all help to the industries in the country. The problems referred to the Central Laboratories by the industries may be classified into following categories:—

I. Those which require laboratory investigation to be carried out for which the minimum charge is Rs. 500/-. The payment is however realized only when the problem has been solved to the satisfaction of the party concerned.

II. Those who desire scientific and technical information available from local and international sources on setting up new industries as well as those which desire technical advice on production or quality control problems of the industries. No charge is made by the Council for rendering help in this category.

The details of the problem under category-I are given below:—

S. No.	Name of party	Problems undertaken
1.	M/s. J.K. Industries, Karachi.	Gloy type adhesive.
2.	M/s. Ahmed Corporation, Karachi.	Corn starch based adhesive paste.
3.	M/s. Omar Industries, Chittagong.	Water proofing composition for Tarpaulin.
4.	M/s. Allibhoy Jafferbhoy & Co. Karachi.	Bitumenistic base for insulating varnish.

The following problems in the above category are under investigation:-

1. Dry colours for cement and paints.
2. Production of zinc oxide from zinc waste.
3. Utilization of waste steel.
4. Formulation of water-proof cement paint.

Details of the problems under category-II are given below:—

	Ref. No. & Date	Name of party	Problems undertaken
1.	Ref. Nil 23.4.59	M/s. Haroon Oil Mills, Karachi.	Methods for determining free fatty acids and estimating losses during the refining of oil therefrom.
2.	FTML-7K-100/59 19.8.1959	M/s. Fateh Textile Mills, Karachi.	Advice on the suitability of a sample of grass found in sind for Rayon manufacture.
3.	Ref. Nil 21.12.59	M/s. Karachi Oil and Seed Industries.	Assistance to the party in solving their difficulties of refining cotton seed oil and minimising the huge losses incurred during refining.
4.	Ac-1/60 23.1.60	M/s. Ahmad Corp., Karachi.	Formulation for the manufacture of casein glue suitable for wood work.
5.	GL-68/60.	M/s. Eastland Industries Corp., Karachi.	Modification of their existing unit for dissolving resins to enablet hem to manufacture pale colour easter gum.
6.	MC/60/1, 2.2.1960	M/s. Durdana Industries, Karachi.	Formulation for transparent adhesive for plastic goods.
7.	Ref. Nil 7.5.60	M/s. Taha & Co. Karachi.	Formulation of Cellulose paints thinner.

8.	LDI/P-5/1071.	Pakistan Steel Corp.	Re-designed their furnace to remove the problem of low production experienced by them.
9.	Tech/936.	M/s. Burmah Shell Oil Storage and Distg. Co. of pakistan Ltd.	Assistance in the preparation of sodium hypochlorite.
10.		Sind Salt Works.	Utilisation of calcium chloride and oxide.
11.		Pak. Oxygen Ltd.	Testing of acetone.
12.		Eastland Industries Corp., Karachi.	Setting up control laboratory for testing raw material and finished products (Printing Ink).

SCIENTIFIC LIAISON

Ref. No. & Date	Ministry/Deptt.	Nature of problem
1. 29.3.59	Principal Survey Officer, Ministry of Industries, Govt. of Pakistan.	Testing of samples of liquid gold.
2. 29.12.1959	I C.A.	Testing of rice bran oil.
3. Lab/2849/60 18.7.60	Chemico Bacteriological Labs. West Pak. Govt.	Test report on the sample of de-naturant.
4. PSI/ASDC/1(2)/60 8.8.1960	Pak. Standard Institution.	Information on the refractive index of local cotton seed oil.
5. DEV/I/28(I)/59 27.7.59	Ministry of Industries.	Comments on (Penoplast) from plastic waste.

6.	9.12.60	Jinnah Central Hospital.	Testing of the oil sample for the presence of 0-Cresyl Phosphate.
7.	TA(I)-20(35)/60	Ministry of Industries.	Comments on recent discoveries of Mr. Herbert Ruthe, Germany.
8,		Ministry of Industries.	Comments on the proposal of PIDC to set up a plant for production of vinyl chloride.
9.		Ministry of Industries.	Comments on suitability of viscose-rayon of acetyl cellulose plant for synthetic fibre manufacturing plant.
10.		Rawal Dam Project.	Analysis of limestone.
11.		Department of Fisheries.	Testing of fish meat.
12.	05795/3/CHEM 29.9.60	Inspectorate of Army Stores and Clothing.	Renovator sample in paste form approved vide letter No. 05795 / 76 / CHEM dated 22.4.61.
13.	IPB/FI(424)/60	Ministry of Industries.	Comments on the feasibility of manufacture of potassium chloride from Dhariala brine.

AD HOC PROBLEMS

A number of ad hoc problems were referred to the Council by the various Government departments, industrialists and other private agencies for technical advice and guidance, which was given as far as possible either by reference to published literature or after carrying out necessary investi-

gations in the laboratories of the Council. Some of the problems on which advice was tendered by the Council are: (1) Manufacture of Penoplast from plastic waste; (2) Economic utilization of waste tobacco and tobacco dust; (3) Manufacture of condensed milk; (4) Suitability of fibrous raw materials for manufacture of Pulp and Paper; (5) Manufacture of Methyl Cellulose; (6) Preparation of Menthal and Tartaric acid; (7) Testing of Liquid Gold; (8) Manufacture of Glycerine; (9) Economic utilization of Celluloid powder; (10) Enamelling of copper wire; (11) Formulation for the preparation of anA dhesive Paste; (12) preparation of Gloy (13) Distillation of vetiver oil; (14) Manufacture of storage batteries and cell; (15) Manufacture of motor battery plates; (16) Refining loss of cottonseed oil; (17) Preparation of antiseptics, automobile and metal polishes; (18) Formula for coating copper wire with tin; (19) Production of Soda Caustic out of ordinary wood-ash, and use of neem oil in soap industry; (20) Manufacture of Chewing Gum; (21) Conversion of PARA dichlorobenzene in the form of Rings and Balls; (22) Economic utilization of calcium chloride obtained as a by-product of Soda Ash and Caustic Soda plant; and (23) Preparation of a colourless transparent sticky solution.

PROBLEMS REFERRED BY INDUSTRIAL CONCERNS FOR TECHNICAL ADVICE AND REPORT TO: 1. WEST REGIONAL LABORATORIES

Sr. No.	Name of the party	Particulars of the problems	Remarks
1.	Ijaz Hussain Shah & Sons, China Clay, Ball Clay, Mine Owners, Karuli, Distt. Jhelum.	Test on China clay as a rubber filler.	Sample was analysed and tested and report sent to the party concerned on gratis.
2.	Ministry of Food & Agriculture, Agriculture Division, Rawalpindi.	Advice with regard to the protection to the indigenous toilet soap industry.	Technical data were supplied and further action is in hand.
3.	Ali Mining Corporation, Abbotabad.	Samples of Galena, Graphite, Red Oxide, White Clay, Yellow Oxide.	Samples were analysed by Glass & Ceramics Div. and report sent to the party concerned on gratis.

4.	Abdul Rehman & Co. Soap Factory, Havelian, Hazara.	Samples of Crystalline, Schist and China Clay for analysis.	Samples were analysed by Glass & Ceramics Div. and report sent to the party concerned on gratis.
5.	M/s. Chemical Glass Industries, Gakhar, Distt. Gujranwala.	Samples of Silica Sand and Zinc Oxide.	—do—
6.	Ali Mining Corporation, Abbotabad.	Graphite samples for analysis.	—do—
7.	General Nazir Ahmed, Mines & Minerals Ltd. Lahore.	Samples of Bentonite from salt range area for analysis.	—do—
8.	Mines & Minerals Ltd., Lahore.	Samples of unrecognised minerals and Bentonite, Bauxite, Fireclay.	—do—
9.	Envoys Ltd., Lahore.	Sample of Bentonite.	—do—
10.	Syed Mohd. Noor, Ali Mining Corpn., Abbotabad.	Sample of Bauxite, Marble, Scheelite & Kyanite.	—do—
11.	Ali Mining Corporation, Abbotabad.	Samples of Fruguist Laterite, Metalled Bauxite, white and Bentonite clays for analysis.	—do—
12.	M/s. Ahmad & Co., Lahore.	Samples of rocks	—do—
13.	Himalya Mineral Corpn., Abbotabad.	Samples of Red Oxide, Yellow Ochre, Soap stone, Calcite, Crystal.	—do—
14.	Shah Ibrahim, Supdt., Irrigation Dept., Lahore.	Samples of Galena and Graphite.	—do—
15.	Mian Aman Ullah Timber Merchant, Jhelum.	Samples of Iron Oxide, Antimony ore, Magnetite ore and a black mineral.	—do—
16.	M/s. Pakistan Glass & Allied Works, Jallo, Lahore.	Samples of ampoules for test.	—do—

17.	M/s. Packages Ltd., Lahore.	Sample of Iso-propyl alcohol.	—do—
18.	M/s. Packages Ltd., Lahore.	Test on Farina Dextrine D-2215.	—do—
19.	M/s. Servis Ltd., Lahore.	Samples of waxparaffin for waxol preparation.	Work on this problem has almost been completed and patent is being applied for.
20.	Choice Industries Ltd., Mclagan Rd., Lahore.	Samples of Red and Yellow Oxides for analysis.	Samples were analysed and report sent to the party concerned on gratis.

2. NORTH REGIONAL LABORATORIES

(*a*) FRUIT TECHNOLOGY: A close liaison was maintained with the local industry and necessary help and guidance were rendered. Help was also given to the Department of Industries for the development of food processingindustries in Pakistan and for laying down standards for qualityof food products. Information on the different aspects of food processing was supplied to the industrialists in Pakistan and United Nations agencies to the extent of facilities available. The Pakistan Standards Institution and the Ministry of Food and Agriculture required technical information on different aspects of food technology which was supplied. The Senior Research Officer attended a number of meetings with the representatives of the Central Ministries and of the United Nations and contributed towards drafting standards for food products and plans for research in food technology.

(*b*) MINERALOGY: The Mineralogical Research Division has rendered regular service to the industries and Government departments connected with mineral exploitation, in analysing samples of ores and minerals referred by them.

Chemical reports on the following ores and minerals were made:

Material	**Reffered by**
Pyrolusite	M/s Khan Mining & Industrial Corpn., Abbotabad.
Magnetite	Deputy Director of Industries, Peshawar.

Lime stone	Deputy Director of Industries, Peshawar.
Pyrites	-do- -do- -do- -do-
Manganese ores	Imperial Paint & Varnish Works, Karachi.
Kalabagh iron ore	Secretary, P.C.S.I.R., Karachi.
Chromite	Amalgamated Mines Ltd., Karachi.
Feldspar	M/s. Abasin Engineering Co. Ltd., Peshawar.

(*c*) INDIGENOUS DRUGS: This Division has also been in touch with the pharmaceutical industries of the locality and have been of use to them in advisory capacity.

XI

APPENDICES

APPENDIX (A)

PAKISTAN COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

LIST OF MEMBERS OF THE COUNCIL

1. Minister for Industries, Govt. of Pakistan, President, C.S.I.R., Karachi.
2. Secretary, Ministry of Industries, Karachi.
3. Financial Adviser (Development), Ministry of Finance, Karachi.
4. Director, Council of Scientific & Industrial Research, Karachi.
5. Col. Zia-ur-Rahman, G.H.Q., Rawalpindi.
6. Chairman, Atomic Energy Commission, Karachi.
7. Chairman, Pakistan Industrial Development Corporation, Karachi.
8. Mr. Nasir A. Shaikh, 5-A, Shah Din Building, The Mall, Lahore.
9. Secretary, Industries & Labour, West Pakistan, Lahore.
10. Secretary, Industries & Labour, East Pakistan, Dacca.
11. Dr. Raziuddin Siddiqui, Vice-Chancellor, Sind University, Hyderabad.
12. Dr. M.H. Khundkar, Dacca University.
13. Mr. M. Ayub, Director, P.I.D.C., Karachi.
14. Mr. Mumtaz Hassan, Planning Commission, Karachi.
15. Secretary, Ministry of Works, Karachi.
16. Col. M. K. Afridi, Vice-Chancellor, Peshawar University, Peshawar.
17. Director, West Regional Laboratories, P.C.S.I.R., Lahore.
18. General Shahid Hamid, Chairman, Small Industries Corporation, Karachi.
19. Dr. A.K.M. Wahid, Director, Health Services, Dacca.
20. Director, East Regional Laboratories, P.C.S.I.R., Dacca.
21. Mr. S. Amir Chinoy, International Industries Ltd., Karachi.

LIST OF MEMBERS OF THE GOVERNING BODY

1. The Minister for Industries, Govt. of Pakistan, (ex-officio, President), Karachi.
2. The Secretary to the Government of Pakistan, Ministry of Industries, Karachi.
3. Director, Pakistan Council of Scientific & Industrial Research, Karachi.
4. Director, East Regional Laboratories, P.C.S.I.R., Dacca.
5. Director, West Regional Laboratories, P.C.S.I.R., Lahore.
6. Director, North Regional Laboratories, P.C.S.I.R., Peshawar.
7. Financial Adviser of the Council.

APPENDIX (B)

STAFF OF THE COUNCIL'S LABORATORIES AND PANSDOC

(AS AT THE END OF 1960)

SALIMUZZAMAN SIDDIQUI	F.R.S., D. Phil. Nat.& D. Med. (Frankfurt a-M).	Director
M. QUDRAT-I-KHUDA	D. Sc. (London), D.I.C., M. Sc.	East Regional Director
KARIMULLAH	D. Phil. Nat. (Heidelberg), Ph. D. (Edinburgh)	West Regional Director
M. O. GHANI	MSc., Ph. D.	North Regional Director

CENTRAL LABORATORIES

Physical Research Division

MAZHAR M. QURASHI	B.A. (Hons.) M.Sc., Ph.D. (Manchester)	Principal Scientific Officer
KHURSHEED HUSSAIN	M. Sc., M. S. (Manitoba)	Research Officer
AHTRAM ALI KHAN	M. Sc.	Research Physicist (Under training in U.K.)
RAFIQ AHMED SIDDIQUI	M. Sc.	Research Physicist (Under training in Canad
SADRUL HASAN RIZVI	M. Sc.	Research Physicist (Under training in U.K.)
ABUL KHAIR BHUIYAN	M. Sc.	Research Physicist (On study leave)
A. K. M. AHSANULLAH	M. Sc.	Research Physicist
S. ABDUL SATTAR	M. Sc.	Research Physicist (Under training in Canada)
S. NOORUL AHMAD	M. Sc.	Research Physicist
A. J. HAMDANI	M. Sc.	Research Physicist
SARFARAZ HASSAN ZAIDI	M. Sc.	Research Physicist
SHAFQUAT HUSSAIN	M. Sc.	Research Physicist (On study leave)
GAZIMUDDIN	M. Sc.	Research Physicist
S. NAZIRUL HASSAN	B. Sc.	Technical Assistant)

Latif Ahmad	M. Sc.	Technical Assistant (On study leave)
Hameed Ahmad	M. Sc.	Technical Assistant (Under training in Australia)
Saeed Ahmad Lodhi	M. Sc.	Technical Assistant
Mir Valayat Ali	M. Sc.	—do—
S. Karamat Hussain	M. Sc.	—do—
M. Tayub Qureshi	M. Sc.	—do—
Fakhruddin Shaikh	M. Sc.	—do—
Mohammad Sabir	B. Sc.	—do—
Mohammad Saulahin	M. Sc.	—do—
S. Rahmat Ali	B. Sc.	Junior Technical Assistant
A. Momin Choudhry	B. Sc.	—do—
S. Wajahat Ali	B. Sc.	—do—
M. Qamar Din		Senior Technician
M. Anwar Baig		Technician
S. A. Malik		Technician (Under training)
S. A. K. Yusufzai		Photographic Assistant

Chemical Research Division

(a) Organic Chemistry

Prof. George Hahn	D. Phil. Nat. (Frankfurt a-M).	Head of Division
Yusuf Ahmad	M. Sc., Ph. D. (London)	Senior Research Officer (On Fellowship in Canada)
Sultan Mohammad	M. Sc., Ph. D. (Manchester)	Senior Research Officer
Serajul Haq	M. Sc., Ph. D. (London)	Research Officer (In Canada on N.R.C. Fellowship)
A. M. Ahsan	M. Sc.	Research Officer (Under training in U.K.)
M. A. Bokhari	M. Sc.	Research Chemist (Under training)
Nasimuddin Siddiqui	M. Sc.	Research Chemist (Under training)
Mushtaq Ismail	M. Sc.	Technical Assistant (Under training)
S. M. Amir	M. Sc.	Technical Assistant
Nisar Ahmad	M. Sc.	—do—

M. A. Hashmi	M. Sc.	Technical Assistant
Ikram Qureshi	M. Sc.	—do—
S. Fazal Hussain	M. Sc.	—do—
Miss Yasmeen Badar	M. Sc.	—do—
Riaz Ahmad	M. Sc.	—do—
L. O. Fernandes	B. Sc.	Junior Technical Assistant
M. Mobin Bhuiyan	B. Sc.	—do—
Mirza Ibrahim Baig	B. Sc.	—do—

(b) Inorganic and Micro Analytical Section

Riaz Ali Shah	M. Sc., Ph., D. (Birmingham) A. R. I. C.	Senior Research Officer
Abdus Salam	M. Sc., Ph. D. (Birmingham)	—do—
S. Jamal Qadir	M. Sc.	Research Officer (Under training in Canada)
Ainul Hassan Khan	M. Sc.	Research Chemist
S. Ishtiaq Ali	M. Sc.	Research Chemist (Under training in U.K.)
Mir Asad Ali	B. Sc.	Technical Assistant
S. A. Hai	B. Sc.	—do—
Tahir Raza Khan	M. Sc.	—do—
Irshad Ahmad Khan	M. Sc.	—do—
Shujat Ali Khan	M. Sc.	—do—
A. M. Rehan	B. Sc. (Hons)	Junior Technical Assistant
Ghulam Ali Ahmad	B. Sc.	—do—
Ziaur Rahman Khan	B. Sc.	Junior Technical Assistant (On study leave)
Mohammad Irfan Khan	B. Sc.	Junior Technical Assistant
S. Abdul Jabbar	Matric	Technician

Bio-Chemical Research Division

S. Mehdihassan	D. Phil. (Giessen) F. I. I. Sc., Dip. Agr. (Oxon)	Head of Division
A. H. Khan	M. Sc., Ph. D. (London)	Senior Research Officer
S. Maqsood Ali	M. Sc.	Research Chemist (Under training in U.K.)
S. A. Haq	B. Sc.	Research Chemist
Rashid Bux Qadri	M. Sc.	Technical Assistant

S. A. Bari	M. Sc.	Technical Assistant
S. Asad Maqsood ali	M. Sc.	—do—
M. Umar Chandana	M. Sc.	—do—
Miss Shakila Siddiqui	M. Sc.	—do—
S. A. Hussain Zaidi	B. Sc.	Junior Technical Assistant

Biological Evaluation Section

Shahid H. Ashrafi	M. Sc., Ph. D. (Karachi),Ph. D. (Ohio)	Senior Research Officer
Abdul Aziz Khan	M. Sc.	Research Entomologist (Under training)
A. M. B. Lutful Kabir	M. Sc.	—do—
Shahid Hassan	M. Sc.	Research Entomologist (Under training in Canada)
M. Anwarullah	M. Sc.	Research Entomologist (Under training in Canada)
S. R. Baqar Rizvi	M. Sc.	Research Entomologist (Under training in Canada)
Iftikhar Ahmad	M. Sc.	Technical Assistant (Under training in Canada)
S. A. Salam Shahidi	M. Sc.	Technical Assistant (Under training in Canada)
M. A. Quddas Khan	M. Sc.	Technical Assistant
M. Ghayasuddin	M. Sc.	—do—
Wahajuddin Roomi	B. Sc.	Junior Technical Assistant (On study leave)

Drugs and Pharmaceuticals Division

S. A. Warsi	M. Sc., Ph. D. (Punjab), Ph. D. (Wales)	Principal Scientific Officer
Manzoor-i-Khuda	M. Sc., Ph. D. (London)	Senior Research Officer
N. H. Khan	M. Sc., M. S. (Syracuse)	Research Officer (On study leave)
M. Allauddin	B. Pharm.	Research Pharmacist (Under training in U.K.)
M. Aslam Butt	M. Sc.	Research Chemist (Under training in U.K.)
Moqaddas ali Khan	M. Sc.	Research Chemist

Mohammad Ameem	M. Sc.	Research Chemist
Nisar Ahmad	M. Sc.	Technical Assistant (Under training)
Veqaruddin	M. Sc.	Technical Assistant
Mohammad Iqbal	M. Sc.	—do—
Miss Nirgas Fatima	M. Sc.	—do—
Miss Sofi Sarela	M. Sc.	—do—
Miss Shahida Qureshi	M. Sc.	—do—
S. Sultan ahmad	M. Sc.	—do—
Abdul Mateen Farid	M. Sc.	—do—
Sardar Ali Khan	B. Sc.	Junior Technical Assistant

Pharamacological Section

Bilquees Jamal Mir	M.B.B.S.	Research Pharmacologist (Under training in U.K.)
Sarfaraz Siddiqui	M.B.B.S.	Research Pharmacologist (Under training in U.K.)
M. Ikhlas Khan B. Sc.,	M.B.B.S.	Research Pharmacologist
Badaruddin Baig	M.B.B.S.	—do—
Ashfaq Ahmad	M.B.B.S.	—do—
Sami Ahmad Khan	Diploma (Vet. Sci.)	—do—
Abuzar	M. Sc., M.B.B.S.	—do—
Mohammad Salim Mir	L.S.M.F.	Technical Assistant
Harun-ur-Rashid	L.S.M.F.	—do—
Riazuddin	L.S.M.F.	—do—

Fuel Research Division and Pilot Plant Station

Prof. H. Von Hoessle	Dr. Ing. (Dressden)	Head of Division
M. Naseem Ahmad	M. Sc., Ph. D. (London)	Senior Research Officer
Sadiq Ali Ahmad	M. Sc.	Research Chemist (Under training in U.K.)
K. V. Ahmad Mustafa	M. Sc.	Coal Analyst
Basit Hasan	B. Sc.	Technical Assistant (Under training in Japan)
Shaukat Hussain	B. Sc.	Technical Assistant
M. Ibrahim Khan	B. Sc.	—do—
Aziz Ahmad Qadri	B. Sc. (Hons)	—do—
Khalil-ur-Rahman	B. Sc.	—do—
Zahid Raza	M. Sc.	—do—
Tufail Ahmad Bhuiyan	B. Sc.	Junior Technical Assistant

Building Materials Division and Building Research Station

S. Tehzibul Hasan	B. E. (Civil)	Senior Research Officer
M. Mubarak Ahmad Ch.	B. Sc.	Research Chemist
Mir Mahmood Ali	B. Sc.	Junior Technical Assistant

Paints and Plastics Research Division

Mohammad Aslam	M. Sc., B. E. (California) Dip. Plastics (U.S.A.)	Senior Research Officer
M. Jamil Khan	B. Sc. (Hons) D.L.T. (London)	Research Officer
Ashad Mehdi	M. Sc.	Research Chemist (Under training in U.K.)
G. Mustafa Ali	M. Sc.	Research Chemist (Under training in New Zealand)
M. Khursheed Alam Khan	M. Sc.	Technical Assistant
S. Ali Hussain	B. Sc.	—do—
S. Hassan Imam	B. Sc.	—do—
M. Zahuruddin	M. Sc.	—do—
Mohammad Hussain	B. Sc.	Junior Technical Assistant
Shafiur Rahman	Matric, Cert. in tanning	Leather Tanning Assistant
Ajmal Khan	Dip. Leather Tech.	—do—
Faiz Ahmad	Dip. Leather Tech.	—do—

Chemical Engineering and Workshop

Abdul Rahman	B.E., M.S. (Canada)	Research Officer
S. M. Ishaq Ali	Dip. Mech. Engg., C. & G. Mech. Engg. (London)	Research Engineer
Mohammad Jahangir	B. E. (Mech.)	Research Engineer
S. Khursheed Naqi Zaidi	B. Sc., B.E. (Mech. & Electrical)	Research Engineer
M. Mohammad Umar	B. Sc., M.S. (Canada)	Research Officer
M. Moinuddin Khan	B. Sc.	Technical Assistant
Mohammad Ameen	A.E.E.T (Pakistan) A.M.I.E.E. (Japan)	Junior Technical Assistant
Mohammad Saleem	Diploma from France	Senior Technician Glass Blower

Administration

Mir Abid Khan	B.A.	Administrative Officer
Shah Mohammad	Matric	Assistant Administrative Officer
Hafizullah	B.A.	Superintendent
J. Deen Ahmad	B.A.	Superintendent

Stores

Riazul Haq Ghazi	B. Sc.	Assistant Stores Officer
Nisar Ahmad Khan	F. Sc. Diploma in Pharmacy	Store Supervisor
Syed Ismail		Senior Store Keeper

Library

A. Muzaffar A. G. Khan	B.Sc. (B.Lib.Sc.)	Senior Librarian
Maqbool H. Qureshi	B.A.,B.T., Dip.Lib.Sc.	Librarian
Mohammad Raisuddin		Cataloguer

PANSDOC

A. R. Mohajir	B. Sc., Ph. D. (Wisconsin)	Head

Documentation Section

A. R. Ghani	M.Sc., Dip. Lib. Sc.	Senior Bibliographer
M. M. Rafique	B.Sc., Dip.Lib.Sc.	Documentation Officer
Akhtar H. Siddiqui	B.A., Dip.Lib.Sc.	Documentation Officer
M. Ahsan Ali Biswas	M.Sc.	Junior Documentation Officer
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EAST REGIONAL LABORATORIES

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Natural Products Division

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Golam Kauser Joarder	M.Sc.	,, ,,
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Lakshmi Narayan Datta	M.Sc.	,, ,,
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Miss Ayesha Khanam	M.Sc.	,, ,,
Asheque Ahmed	M.Sc.	,, ,,

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Majibur Rahman	M.Sc.	,, ,,
Shamsur Rahman Khan Lohani	M.Sc.	,, ,,
A.F.M. Aminul Islam	M.Sc.	,, ..
Aminuddin Mia	M.Sc.	,, ,,
Shah Abdul Majid	M.Sc.	,, ,,
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Sadrul Amin	B.Sc.	,, ,, ,,
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Food and Fruit Research Division

Hari Nath De	M.Sc., Ph.D.(Dac.)	P.S.O.
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Khandaker A. Q. M. Quddusur Rahman	M.Sc.	,, ,,
Omer Faruque	M.Sc.	,, ,,
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M. Aminul Islam	M.Sc.	,, ,,
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Glass & Ceramics Research Division

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Shamim Jahangir Ahmed	M.Sc.	,, ,,
Siddique Ahmed I	M.Sc.	,, ,,
Nirmal Kumar Das	M.Sc.	,, ,,
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Fuel Research Division

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Zillur Rahman	M.Sc.	,, ,,
Nazmul Hasan	M.Sc.	,, ,,
Muhammad Muslem	M.Sc.	,, ,,
Abdur Rashid	M.Sc.	,, ,,
Tofail Ahmed Bhuiya	B.Sc.	Jr. Technical Asstt.
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Leather Research Division

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WEST REGIONAL LABORATORIES

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Metallurgical and Ore Dressing

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MUHAMMAD YOUNIS	B.Sc.	,, ,,

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MUHAMMAD INAM KHOKHAR	M.Sc.	,, ,,
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Drugs and Pharmaceuticals Division

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ABDUL MAJID HAMID	M.Sc.	,, ,,
NAZAR MUHAMMAD	M.Sc.	,, ,,
MUHAMMAD AKRAM SANDHU	M.Sc.	,, ,,
FAZAL MUHAMMAD KHAN	M.Sc.	,, ,,
ILYAS AHMAD	M.Sc.	Jr. Tech : Assistant

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M. Abdul Qadeer	M.Sc.	,, ,,
M. Afzal Malik	M.Sc.	,, ,,
Abdul Sittar Alavi	M.Sc.	,, ,,
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Physics and Electronics Section

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Ehsan Ullah Khan	M.Sc.	,, ,,
Saif-ur-Rehman	M.Sc.	,, ,,
Manzoor Mehdi Khan	M.Sc.	,, ,,

Glass and Ceramics Division

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M. R. Ariff	M.Sc. (Japan)	,, ,, ,,
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Ghulam Rasul	M.Sc.	,, ,,
Muhammad Yasin	M.Sc.	,, ,,
Muhammad Ibrahim	M.Sc.	,, ,,
M. Hanif Qureshi	M.Sc.	,, ,,
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Nutrition Section

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M. Yousuf Ikramul Haq	B. Sc.	Jr. Tech: Assistant

Oils & Fats Division

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M. Ilyas Qureshi	M. Sc.	,, ,,
Iftikhar Ahmad	M. Sc.	,, ,,
Shafiq Ahmed Khan	M. Sc.	,, ,,
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Naseer-ud-Din Zahid	M. Sc.	,, ,,
Nasir Ahmad	M. Sc.	,, ,,
Naeem Shakir	M. Sc.	,, ,,
Ehsan-ul-Haque	M. Sc.	,, ,,
Khan Muhammad Khan	M. Sc.	,, ,,
Mehboob Ilahi	M. Sc.	,, ,,
Muhammad Saleem	M. Sc.	,, ,,
Jameel-ur-Rehman	M. Sc.	,, ,,
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Manzoor Elahi	M. Sc.	,, ,,

Administration

B. A. Sajid	B. A.(Hons) Dip. Jour., Cert.Russian	Administrative Officer

Ch. Fateh Muhammad	M. A.	Accounts Officer (Part time)
M. H. Alavi	M. A.	Office Superintendent
S. W. Zaman	B. A. (Hons)	Estate Superintendent
	Engineering	
Mian Badar-ud-Din	M. A.	Technical Officer
	Store	
Mian Muhammad Sharif	M.Sc.	Technical Officer
	Workshop	
Jamil Ahmad Jaffri	B.Sc. (Engg)	Technical Assistant
	Library	
Nazir Ahmad	B. Sc.	Librarian

NORTH REGIONAL LABORATORIES

Indigenous Drugs Research Division

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M. Ikram	M. Sc., Ph. D. (Italy)	Senior Research Officer
M. A. Wahid	M. Sc.	Research Officer
N. A. Malik	M. Sc.	Research Botanist
H.K.M. Abdul Hye	M..B.B.S.	Research Officer (Pharm)
A.Q.S. Bukhari	M.B.B.S.	,, ,,
Azizuddin Ahmad Natawala	,,	,, ,,
Mujahid Hussain Khan	,,	,, ,,
G. A. Miana	M. Sc.	Research Chemist
S. M. A. Kazmi	B. Sc.	Technical Assistant
M. Anisur Rehman	M. Sc.	,, ,,
M. Islam	B. Sc.	Jr. Tech: Assistant

Mineral Division

M. Nabi Bakhsh	M. Sc., M. S. (M. I.T., U.S.A.)	Senior Research Officer
M. A. K. Yusufi	M. Sc., D. E. S. (Ncy) A.S.T.E.F. (Dy) Paris	Research officer
Fazal Muhammad	M. Sc.	Technical Assistant
Mushtaq Hussain	M. Sc.	,, ,,
M. Amin	M. Sc.	,, ,,
M. A. Khattak	B. Sc.	,, ,,
M. Hussain	M. Sc.	,, ,,
M. Yunis	B. Sc.	Jr. Tech. Assistant

F. T. Division

J. N. Khattak	B. Sc. (Cert. Fruit Technology (N. S. Wales)	Research Chemist
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Fazlur Rehman	M. Sc.	Technical Assistant
N. A. Sufi	M. Sc.	,, ,,
Jameel Ahmed Khan	M. Sc.	,, ,,
M. Ismail	B. Sc.	Jr. Tech. Assistant

Wool Research Division

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MUMTAZ AHMED	M. Sc.	Technical Assistant

Administration

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Engineering

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Stores

RAFIQ AHMED KHAN	B. Sc.	Stores Supervisor

Workshop

ZAFAR IQBAL		Foreman

APPENDIX (C)

PUBLISHED PAPERS, BIBLIOGRAPHIES AND TRANSLATIONS

1. PUBLISHED PAPERS

(a) ORGANIC CHEMISTRY INCLUDING PLANT PRODUCTS

1959

AHMAD, NISAR and HAHN, GEORGE, Studies on *Centaurea behen* Linn. (Compositae). Part I. *Pakistan J. Sci. Ind. Research*, 1959, 2, 55-61.

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1959

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320	*German*	Lissner, A. & Nemes, A. Experiments on the decomposition of carbo-sulphates. *Brennst Chemie*, 15 March, 1935, 16 (6), 101 - 107.
321	*German*	Leuchte, G. Process for the production of paint-substances from tall oil, *German Patent No.* 711076, 21 Aug. 1941.
326	*Japanese*	Matsukawa, T. & Shoji, K. The hardness testing of metal-graphite brushes, *Tauso*, 1958, 6, P. 2-4.
328	*Dutch*	Germans, F. H. Bonded-fibre fabrics will increase the total demand for textiles, *Tex.*, Jan. 1960, p.9-14.
333	*German*	Kemner, H. "Tallol" (liquid resin) in paint industry. *Farb. Lack. Anstrichst.* 1947, No.2, p.p. 20-21.
334	*German*	Schade, W. Method for producing a varnish substitute from tallol (liquid resin). *German Patent No.* 705939.
336	*French*	SERVICE DES RECHERCHES TECHNIQUES DE LA S. F. C. Laboratory methods for studying rocks used in ceramics. *Publ. Soc. franc. cer.*, 1956, pp. 97—105.
337	*French*	SERVICE DES RECHERCHES TECHNIQUES DE LA S. F. C. Rapid diagnosis of chemical nature of silicates. *Publ. Soc. franc. cer.*,1956, pp. 151-157.
344	*German*	Burkart, W. Porous concrete as a building and insulating material. *Chem. Tech.*, 1942, 15, 226 - 227.
370	*French*	Pourbaix, M. Use of electrochemical methods at a high temperature. *Cent. Belg. Etude Corrosion.*, circular, 9 March 1960.

Translation No.	Original language	Bibliographical Details
234	*German*	Reichstein, J. & Grussner, A. A productive synthesis of l-ascorbic acid (Vitamin C). *Helv. Chim. acta*, 1934, **17**, 311-328.
245	*German*	Meir, R. et al. Quantitative characterization of the lowering of blood pressure by various kinds of hypotensive substances. *Arch. int. Pharmacodyn.*, 1955, **101** (2), 158-170.
248	*French*	Tripod, J. & Meir, R. The effect of serpasil (Reserpine, a new alkaloid of Rauwolfia serpentina B.) on isolated circulation organs. *Arch. int. Pharmacodyn.*, 1954, **97** (3/4), 251-266.
250	*German*	Rothlin, E. Von & Schlach, W. R. Pharmacology and toxicology of scillaroside and scillirosidine. *Helv. physiol. acta*, 1952, **10** (4), 427-437.
254	*German*	Rothlin, E. Von & Suter, E. The effect of glycosides on electrocardiograms and the myocardiogram. Part I: Comparative electro-cardiographic investigations of various cardio-active glycosides following intravenous infusion. *Helv. physiol. acta*, 1947, **5** (3), 298-321.
260	*Hebrew*	Shalon, R. Air entrained concrete and suggestion for its use in Israil. *Israil Inst. Technol. Bull.* No.23.
266	*Japanese*	Hutukaiti, S. On tetraploid Asiatic cotton plant induced by colchicine treatment. *Bot. & Zool., Tokyo*, 1940, **8**, 597-601.
273	*German*	Schlittler, E. et al. Isolation of alstonin from African Rauwolfia Spp. *Helv. Chim. acta*, 1952, **35** (1), 271-76.
276	*German*	Koczy, G. Determination of uranium in samples of sea water. *S. B. Ostr. Akad. Wiss. Math. Nat. Klass.*, Abt. IIa, 1950, **158**, 113-121.

Translation No.	Original language	Bibliographical Details
285	*Russian*	Yurovsky, A. Z. et al. Beneficiation of coal and waste-products of coal. *J. Chem. Ind. USSR*, 1940, **17** (3), 81-13.
286	*German*	Burstrom, H. Unfolding and rolling of a mesophilic grass leaf. *Bot. Notiser*, 1942, pp. 351-61.
302	*German*	Stocker, O. Problems of drought resistance of plants. *Naturwissenschaften*, 1947, **34**, 362-371.
307	*French*	Steopoe, J. Spermatogenesis in *Naucoris cimicoides*. *C. R. Soc. Biol. Paris*, 1929, **102**, 1116-1118.
308	*French*	Hirschler, J. A. primary and secondary Golgi apparatus in the spermatides of *palomena viridissima* Poda (Rhyncote-Pentatomide). *C. R. Soc. Biol. Paris*, 1929, 101, 850-852.
309	*Danish*	Hagerup O. Studies of cucurbitaceae and passifloraceae. *Dansk. bot. Ark.*, 1930, 6 (4), 97-99. (Summary only).
313	*Hungarian*	Darvas, J. et al. A new substance effective for immunization against cholera and some problems in the pathology of that disease. *Napegeszsegugy*, 1950, No. 3, pp. 43.
315	*Hungarian*	Leczfalvy, S. Some problems of evaporation of ground water. *Hidrol. Kozl.* Aug, 1959, 39 (4), 279-284.
325	*Japanese*	Watanabe, T. Self-lubricating Fe-Cu bearing. I. Mechanism of pore formation. *Rep. Govt. Indust. Res. Inst. Nagoya*, Oct. 1958, (7), 743-752.
340	*French*	Bertrand, G. Biochemical preparation of sorbose. *Bull. Soc. Chem.* 1896, 15 (3), 627-31.

Translation No.	Original language	Bibliographical Details
342	*Russian*	Strogonov, B. P. The adaptation of cotton plants to soil salinity. *Dokl. Akad. Nauk. USSR*, 1946, **54** 457-460.
345	*Hungarian*	Dezso, P. The scientific activity of Lorand "otvos, on the twentieth anniversary of his death. *Term-Tud. Kozl.*, 1939, pp. 1-11.
348	*German*	Muller, H. J. Intracellular Symbiosis of *Cixius nervosus* L. and *Fulgora europaea* L. (*Homoptera cicadina*) as examples of polysymbiotic cycles. *VII Int. Congr. Ent.*, 1939, **2**, 877-84.
349	*Italian*	Teodoro, G. Observations on the muscular system of genus ceroplastes. *P.V.Soc. tosc. Sci. nat.* 1943, 52, 13-15.
380	*Russian*	Genkel, N. A. & Kolotova,S.S.A comparative method of assesing the degree of salt resistance of cotton. *Dokl. Akad. Nauk. USSR*, 1943, 39 (5), 209-212.
391	*French*	Locquin, M. Identification of a complex structure in a collection. *C. R. Acad. Sci. Paris*, 25 June 1960, 250 (4), 659-60.
397	*German*	Kleinsorge, H. Clinical investigations of the nature of the action of the Rauwolfia alkaloid ajmaline in disturbances of cardiac rhythm particularly extrasystoles. *Med. Klin.*, 1959, No. 10, 409-416.
398	*German*	Zeschke, G. Uranium-bearing fluoride deposits. *Z. Erzberg. MetallhuttenW.*, 1957, 10 (7), 1-7.
400	*French*	Astaldi, G. Bone marrow in aplastic anemias. *Sem. Hop. Paris*, 1954, 30 (43), 3102-3110.
401	*German*	Schulz, G. Behaviour of blood protein in various forms of anemia. *Die Medizinische, Stuttgart*, 13 Feb. 1954. No. 7, 226-229.

Translation No.	Original language	Bibliographical Details
407	*German*	Beutler, R. Time and space in the life of the worker bee. *Naturwissenschaften*, 1950, 37 (5), 102-105.
415	*French*	Villoutreix, J. Carotenoids of *Rhodotorula mucilaginosa. Biochem. biophys. Acta*, 3 June 1960, 40 (3), 442-57.
416	*French*	Villoutreix J. Influence of various chemical agents on the caotogenesis of *Rhodotorula mucilaginosa. Biochem. biophys. Acta*, 3 June 1960, 40 (3), 432-441.
419	*German*	Volkner, E. Casuistic contribution on the treatment of paroxysmal tachycardia with ajmaline. *Med. Klin.*, 12 Feb. 1960, 55 (7), 266-269.
420	*German*	Kleinsorge, H. The mode of action of Rauwolfia alkaloid ajmaline in disturbances of the heart rhythm, *Verh. dtsch. Ges. inner. Med.*' 65th Congr., 1959, pp. 586-591.
421	*German*	Kleinsorge, H. & Straubing, S. Comparative investigation of the inotropic effect of ajmaline and procainamide. *Klin. Wschr*, 15 March 1960, 38 (6), 290-291.
422	*French*	Sureau, P. Recent information about the epidemiology of the entero-viruses in Madagascar. *Paper presented at the 4th Congr. P.I.O.S.A.* Karachi Nov. 1960.
423	*French*	Paulin, R. The Zoology of Madagascar. *Paper presented at the 4th Congr. P.I.O.S.A.* Karachi, Nov. 1960.
424	*French*	Battistini, R. The littoral quaterrary of Madagascar. *Paper presented at the 4th Congr. P.I.O.S.A. Karachi*, Nov. 1960.
425	*French*	Leandri, J. Role of France in the botanical researches carried out in Madagascar. *Paper presented at the* 4th *Congr. P.I.O.S.A. Karachi, Nov.* 1960.
438	*Russian*	Piryatinskii, A. L. & Bardyshev, I.I. Method for obtaining varnish resins. *U.S.S.R. Patent No.* 6948. 31 Oct. 1947.

APPENDIX (D)

(*a*) P. C. S. I. R. SECRETARIAT

Dr. Salimuzzaman Siddiqui		Director, Scientific and Industrial Research
A. H. Chotani	.. ..	Secretary, P.C.S.I.R.

(*i*) *Administration*

M. A. Salam	.. ..	Assistant Secretary
S. A. Rahman	.. ..	Accounts Officer
Masud Ahmad Khan	.. ..	Personal Secretary to D.S.I.R.
Kamaluddin Ansari	.. ..	Superintendent
M. Abdullah Bhatti	.. ..	Superintendent
A. Q. Deshmukh	.. ..	Superintendent
Mumtaz Hussain	.. ..	Superintendent
Rafiq Ahmad	.. ..	Superintendent

(*ii*) *Patents, Research Utilization, Planning and Industrial Liaison*

M. A. Haleem	.. ..	Patent Officer
Zahuruddin	.. ..	Assistant Secretary
A. Majid Khan	.. ..	Executive Officer
Habib Ahmad	.. ..	Superintendent
S. M. Imtiaz	.. ..	Superintendent
Absar Ahmad	.. ..	Superintendent
M. Mohammad Umar	.. ..	Scientific Assistant
K. Kamaluddin	.. ..	Scientific Assistant
A. Fayazuddin	.. ..	Technical Assistant

(*iii*) *Engineering*

A. Samad Khan	.. ..	Senior Engineer

(*b*) FINANCE

Annual Budget

The year-wise budget provisions for the Council are as shown below:-

April 1958 - June 1959	Rs. 1,40,00,000
July 1959 - June 1960	Rs. 90,00,000
July 1960 - June 1961	Rs. 1,30,00,000

Pakistan Council of Scientific and Industrial Research Annual Accounts 1958-59 (April 1958 to June 1959).

PAYMENTS

Head of Account	Council's Secretariat, Karachi	Central Laboratories, Karachi	Pansdoc, Karachi	West Regional Laboratories, Lahore	East Region. Laboratories, Dacca	North Reg. Laboratories, Peshawar
1. Pay of Officers	92920- 9- 0	362936- 8- 0	75008-12- 0	127444- 8- 0	136880- 2- 0	30639 -7- 0
2. Pay of Establishment	331203-10- 0	582365-14- 0	44730- 5- 0	269275- 3- 0	176551- 6- 0	123444- 7- 0
3. Allowances & Honoraria	137666- 2- 0	256754- 2- 0	29621- 5- 0	123125- 2- 0	125350- 0- 9	52791- 2- 0
Total Pay & Allowances:	561790- 5- 0	1202056- 8- 6	149360- 6- 0	519844-13- 0	438781- 8- 9	206875- 0- 0
4: **OTHER CHARGES:**						
'A' Capital Expenditure						
i) Acquisition & Dev. of lands						
ii) First phase of planning Construction & equip. of Labs.	174557- -0- 0	2992- 4- 0	—	1314800-12- 3	1290287-11- 9	865045- 4- 3
iii) Construction of Qrts.						
'B' Running Expenditure						
iv) Addition & Alter. to existing premises	7480- 3- 0	7482- 0- 0	2000- 0- 0	2777- 8- 0	3659- 4- 0	959- 3- 0
Furniture, Fixture & fittings	8364- 0- 0	42517-10- 0	1799- 0- 0	26123-13- 6	—	12853- 2- 0
v) Lab. Apparatus Appl.	1389- 8- 0	22272-13- 0	3835- 6- 0	113086- 1- 6	35246-15- 1	13078- 7- 0

vi)	Construction of Pilot Plant Shed	—	—	—	—	—	—
vii)	Pilot Plant Unit Process Equipment	—	9885-14- 0	—	—	—	—
viii)	Scientific Books & Journals	78-12- 0	104623- 0- 6	20- 0- 0	32683-11- 0	45498-10- 0	23853- 5-9
ix)	Chemicals, Solvents & Raw Materials	—	68028- 0- 9	165- 4- 0	21382-14- 3	13499- 7- 6	8811-15-3
x)	Workshop Equipment & Tools	—	107144- 3- 0	—	78554- 1- 9	31010- 8- 0	63083-10- 6
xi)	Rent of Buildings, Labs., Premises etc.	—	707- 0- 0	19770- 3- 0	—	—	60- 0- 0
xii)	Petrol Gas Plant	—	—	—	930- 0- 0	—	362- 1- 0
xiii)	Misc. contingencies	176130-13- 6	120770- 9- 1	26102-15- 6	104764-14- 3	40220- 3- 6	64968- 8- 0
xiv)	Foreign Purchases	137497- 5- 2	—	—	—	—	—
xv)	Clearance of Imported goods, Customs duties, Sales tax etc.	(-)51761- 3- 0	—	—	—	11297- 6- 0	1421- 5- 0
xvi)	Purchase of UNESCO Coupons	—	—	70886- 6- 6	—	—	—
xvii)	Income-tax payable by Council on behalf of foreigners in the services of the Council	10668-12- 0	—	—	—	—	—
xviii)	Printing of Journals	3803- 8- 0	—	—	—	—	—
xix)	Expenditure on UNESCO Experts	5078- 0- 0	—	—	3225-14- 6	—	—
xx)	Indelible Ink Account	—	103700- 8- 0	—	—	—	—
5.	Provision for Scientific Research Scheme	93689- 6- 3	—	—	—	—	—
6.	Delegation to Foreign countries	(-)1447- 6- 0	—	—	—	—	—

.7	Award of Fellowship/Scholarship/Study leave	190210-14- 9	—	—	—	—	—
8.	Pension & Leave Salary contributions	13539- 2- 3	404- 4- 0	1811- 4- 6	4670- 5- 0	4407- 9- 0	8903- 9- 0
9.	Council's contribution towards C. P. Fund	77219- 0- 0	—	—	—	—	—
	Total Other Charges:	846497-11-11	590528- 2- 4	126390- 7- 6	1703000- 0- 0	1475127-10-10	1063400- 6- 9
10.	**Deposits & Advances:**						
i)	Cycle advance	6800- 0- 0	8500- 0- 0	1250- 0- 0	3020- 0- 0	2200- 0- 0	3000- 0- 0
	Less recoveries:	(-)5932-12- 0	(-)7187- 0- 0	(-)679- 0- 0	(-)1323- 0- 0	(-)1366- 0- 0	(-)2445- 0- 0
	NET:	867- 4- 0	1313- 0- 0	571- 0- 0	1697- 0- 0	834- 0- 0	555- 0- 0
ii)	Motor Car/Cycle Adv.	31303- 0- 0	32836- 0- 0	9240- 0- 0	—	—	4365- 0- 0
	Less recoveries:	(-)18654-12- 0	(-)28297-11- 0	(-)2702- 0- 0	(-)1212- 8- 0	—	(-)2226- 4- 0
	NET :	12648- 4- 0	4538- 5- 0	6538- 0- 0	(-)1212- 8- 0	—	2138-12- 0
iii)	House Repair Adv.	—	—	—	—	—	—
	Less recoveries:	(-)1302- 0- 0	—	(-)26- 0- 0	—	—	—
	NET:	(-)1302- 0- 0	—	(-)26- 0- 0	—	—	—

iv)	Objection Book Adv.						
	(*a*) Gazetted Officers	—	(-)1600- 0- 0	—	—	—	—
	(*b*) Non-Gazetted	—	(-)64- 0- 0	—	—	—	—
	(*c*) Misc. Adv. adjustable:	(-)1273-11- 4	3- 1- 0	—	(-)22299- 4- 3	(-)17420- 5- 0	56387-11-- 0
	Total Deposit & Advances	933-12- 8	4190- 6- 0	7083- 0- 0	(-)21814-12- 3	(-)16586- 5- 0	59081- 7- 0
11.	Building Res. Station	—	2545- 0- 0	—	—	—	—
12.	Reserve Fund	—	—	—	—	—	—
	Total Service Heads	1419221-13- 7	1799320- 0-10	282833-13- 6	2201030- 0- 9	1897322-14- 7	1329356-13- 9
	Combined total all service Heads, Council Sectt., Central Labs. & Pansdoc, Karachi.	3501375-11-11	—	—	—	—	—
13.	Closing balance 30.6.1959.	710570- 8-11	—	—	136607- 3- 9	960564-12- 2	343858-10- 3
	GRAND TOTAL:	4211946- 4-10	—		2337637- 4- 6	2857887-10- 9	1673215- 8- 0

Sd/-
(A. K. Deshmukh)
Superintendent

Sd/-
(S. A. Rahman)
Accounts Officer

Sd/-
(A. H. Chotani)
Secretary, CSIR

Pakistan Council of Scientific and Industrial Research Annual Accounts 1959-60 (July 1959 to June 1960).

PAYMENTS

Head of Account	Council's Secretariat, Karachi	Central Laboratories, Karachi	Pansdoc, Karachi	West Regional Laboratories, Lahore	East Regional Laboratories, Dacca	North Regional Laboratories, Peshawar
1. Pay of Officers	76793-11- 0	376692-11- 0	54666- 8- 0	121649-11- 0	132626- 4- 0	44676- 1- 0
2. Pay of Establishment	273264- 4- 0	524213- 3- 0	42255- 5- 0	258904-12- 0	178108- 8- 0	101923- 5- 0
3. Allowances & Honoraria	140648- 9- 0	305809- 9- 9	26859-14- 0	121184- 2- 3	93030- 5- 0	51053-11- 0
Total Pay & Allowances :	490706- 8- 0	1206715- 7- 9	123781-11- 0	501738- 9- 3	403765- 1- 0	197653- 1- 0
4. OTHER CHARGES:						
'A' Capital Expenditure						
i) Acquisition & Dev. of lands *ii)* First phase of Planning Construction & equip. of Labs. *iii)* Construction of Qrts.	11246-11- 0	—	—	1089203- 7- 9	870327-14- 3	1002932-11- 6
'B' Running Expenditure						
iv) Addition & Alter. to existing Premises. Furniture, Fixture & fittings:	243- 8- 0	12302- 8- 0	12156-15- 9	4371-13- 0	—	108614- 7- 0
	16751- 9-0	55450- 1- 0	—	36186-12- 0	—	—
v) Lab. Apparatus Appl.	—	90319- 2- 6	376- 6- 0	136222-14- 0	56011-10- 3	14430- 8- 0

vi)	Construction of Pilot Plant Shed	—	—	—	—	—	—
vii)	Pilot Plant Unit Process Equipment	—	4471- 3- 0	—	—	—	—
viii)	Scientific Books & Journals	—	27463- 0- 9	—	59850- 4- 0	24463-12- 0	2206- 7- 0
ix)	Chemicals, Solvents & Raw Materials	—	82566-11- 6	200- 5- 0	20746-12- 6	7558-14- 9	9405- 3- 3
x)	Workshop Equipment & Tools	—	90786- 5- 9	—	44416- 8- 0	19956- 1- 3	21911- 2- 9
xi)	Rent of Buildings, Labs. Premises etc.	3825- 0- 0	827- 0- 0	10284- 6- 0	—	—	15- 0- 0
xii)	Petrol Gas Plant	—	—	—	774- 3- 0	—	535- 1- 0
xiii)	Misc. contingencies	102730- 4- 3	135387-12- 0	15114- 4- 3	88628-13- 9	82856- 4- 3	48709-13- 0
xiv)	Foreign Purchases	1618109- 3- 3	—	—	—	—	—
xv)	Clearance of Imported goods, Customs duties, Sale tax etc.	193575- 3- 6	—	—	—	(-)11281-11- 0	6945- 2- 6
xvi)	Purchase of UNESCO Coupons	—	—	40000- 0- 0	—	—	—
xvii)	Income-tax payable by Council on behalf of foreigners in the services of the Council	—	—	—	—	—	—
xviii)	Printing of Journals	889-15- 6	—	—	—	—	—
xix)	Expenditure on UNESCO Experts	7467-13- 0	—	—	—	—	—
xx)	Indelible Ink Accounts	—	—	—	—	—	—

5. Social Welfare Funds	5000- 0- 0	—	—	—	—	—
6. Provision for Scientific Research Scheme	61000- 0- 0	—	—	—	—	—
7. Delegation to Foreign Countries	8830- 7- 0	—	—	—	—	—
ii) Science Conference, Symposium & Seminars	—	—	—	—	—	—
8. Award of Fellowship/Scholarships/Study leave	91009- 3- 3	—	—	—	—	—
9. Pension & Leave Salary Contributions	9644-13- 5	22-12- 0	—	—	1200-13- 0	11- 8- 0
10. Council's contribution towards C.P. Fund	111366- 0- 0	122- 0- 0	—	—	—	—
11. Councils contribution towards House rent	25524- 5- 0	—	—	—	—	—
Total Other Charges:	2267213- 7- 2	499898- 8- 6	78132- 5- 0	1480401-8 - 0	1051093-10- 9	1215717- 0- 0
12. **Deposits & Advances:**						
i) Cycle advance	4400- 0- 0	5000- 0- 0	1450- 0- 0	4160- 0- 0	750- 0- 0	2000- 0- 0
Less recoveries:	(-)5092- 3- 0	(-)4759- 0- 0	(-)961- 1- 0	(-)2756- 4- 0	(-)1258- 0- 0	(-)1623- 0- 0
NET:	(-)692- 3- 0	241- 0- 0	488-15- 0	1403-12- 0	(-)508- 0- 0	377- 0- 0
ii) Motor Car/Cycle Adv.	43112- 0- 0	39111- 0- 0	6340- 0- 0	20300- 0- 0	12580- 0- 0	3200- 0- 0
Less recoveries:	(-)27236-14- 0	(-)21340- 7- 0	(-)3225- 0- 0	(-)1620- 0- 0	--	(-)1641- 0- 0

NET:	15875- 2- 0	17770- 9- 0	3115- 0- 0	18680- 0- 0	12580- 0- 0	1559- 0- 0
iii) House Repair Adv.	—	—	—	—	—	—
Less recoveries:	(-)34- 0- 0	—	—	—	—	—
NET:	(-)34- 0- 0	—	—	—	—	—
iv) Objection Book Adv.						
a) Gazetted Officers						
b) Non-Gazetted						
c) Misc. Adv. adjustable: (Sectt.)	599-15- 0					
Misc. Adv. adjustable: (C. Labs.)	16650- 0- 0					
Misc. Adv. adjustable: (Pansdoc)	425- 0- 0	150- 0- 0	60- 0- 0	(-)15288-10- 0	—	15008-12- 9
d) Special Adv. drawn in cash by Sectt. subject to adjustment	23847- 9- 6					
Total Deposit & Adv:	56671- 7- 6	18161- 9- 0	3727-15- 0	4795- 2- 0	12072- 0- 0	16944-12- 9
13. Building Research Station	—	42873- 1- 0	—	—	—	—
14. Reserve Fund	—	—	—	—	—	—
15. Grant to Scientific Commission	85500- 0- 0	—	—	—	—	—

16.	PIOSA	—	—	—	—	347-13- 6	—
	Total Service Heads	2900091- 6- 8	1767648-10- 3	205577-15- 0	1986935- 3- 3	1467278- 9- 3	1430314-13- 9
	Combined total all service Heads, Council Sectt., Central Labs. & Pansdoc, Karachi.	4873317-15-11	—	—	—	—	—
17.	Closing Balance 30.6.1960.	1065074-12- 0	—	—	403221- 0- 6	1628560-10- 8	578149- 4- 6
	GRAND TOTAL:—	5938392-11-11	—	—	2390156- 3- 9	3095839 -3-11	2008464- 2- 3

Sd/-
(K. Ansari)
Superintendent

Sd/-
(S. A. Rahman)
Accounts Officer

Sd/-
(A. H. Chotani)
Secretary, CSIR

APPENDIX (E)

EDITORIAL BOARD OF THE JOURNAL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

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